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GENERAL PATHOLOGY.

A TREATISE

ON

GENERAL PATHOLOGY.

BY

DR. J. HENLÉ,

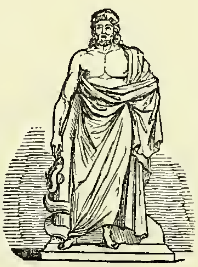
PROFESSOR OF ANATOMY AND PHYSIOLOGY, IN HEIDELBERG.

TRANSLATED FROM THE GERMAN,

BY

HENRY C. PRESTON, A.M., M.D.,

BIBLIOTH. COLL. REG. MED. EDIN.



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TRANSLATOR'S PREFACE.

The fact that Pathology is now universally recognised as a fundamental branch of medical science, and the almost entire absence of a complete standard work on this subject, in our English medical literature, is a sufficient apology for the appearance of this work in its present form.

Prof. Henlé's eminent character as a distinguished medical teacher, and as the best modern pathological author, is too well known among German students, to need more than the announcement of his name and his work to insure an enthusiastic and grateful reception in the medical literature of any country or language. But for the sake of those who may not be conversant with German literature, I have thought best to preface this volume with the following brief sketch of the public career of the author, for which I am indebted to a medical friend who has enjoyed his personal acquaintance.

Dr. Jacob Henlé is a native of Coblentz, on the Rhine. He received his academic and medical education principally at the University of Bonn, where he graduated in 1830. At that time, John Müller was making his numerous brilliant experiments and investigations, for the purpose of establishing a pure physiology founded on the natural sciences. To these studies, which necessarily required extensive and exact microscopic observations in anatomy, Henlé betook himself with great zeal and success; so much so, that when Müller took the chair of Anatomy in Berlin, Henlé was appointed his prosector. The greater advantages which Berlin afforded, gave to both a better opportunity

of prosecuting their important studies, and especially of extending their researches in Comparative Anatomy and Physiology.

As the whole effort of Müller's school was directed towards establishing the science of medicine upon a certain and natural scientific basis, so the practical genius of Henlé always sought for points of connexion between the results obtained by the newly flourishing auxiliary sciences and those of practical medicine. As the first requisite of a rational medical practice, he felt the necessity of a complete remodelling, or new foundation of Pathology. To this end, therefore, he particularly directed his attention; and with what brilliant success, we have a speaking evidence in his "Handbuch der Rationellen Pathologie," the first volume of which appeared in Braunschweig in 1846. Previously, and as preliminary to this work, he published in 1840 his "Pathologischen Untersuchungen," in Berlin; a work which, in the highest degree, agreeably surprised the medical world, but of which no second edition appeared, probably because he had then commenced the present extensive treatise. The most important work for which we are indebted to the ingenious investigation and indefatigable labor of Henlé, is unquestionably his "Allgemeine Anatomie," which appeared in Leipsic in 1841, and which has already obtained a classical authority in all the medical schools of the old world.

Prof. Henlé himself has probably never been much engaged in the practice of medicine, because his important investigations left him no time; but in order the better to understand the wants of practice, and to be able always to prove practically the applicability of his discoveries in the auxiliary sciences, he formed a connexion with his eminent friend, Dr. C. Pfeufer. Associated with him, Henlé spent several years in Zürich, teaching and pursuing his investigations, and, since 1844, in Heidelberg; in the Universities of both which places, Henlé was Professor of Anatomy and Physiology, and Pfeufer Professor of Practical Medicine and Director of the Hospital. The most important results of this scientific alliance have been, from time to time, communicated in the "Zeitschrift für Rationelle Medizin," published by these two gentlemen for the last ten or twelve

years. Besides these works, Henlé has written several monographs and supplements for Canstatt's "Jahresberichte."

Personally, Dr. Henlé is an extremely amiable and unpretending man, a jovial companion, and a warm, true friend. He enjoys the greatest popularity among the students, and is universally esteemed as a dignified and strictly moral man.

A short time since, the University of Göttingen announced Prof. Henlé's lectures for the present winter at that institution; but still later accounts state that he has accepted a call to Munich.

Thus much for the author. For any imperfections of my English version, I must ask the indulgence of the Profession, only suggesting, that those who have never attempted the difficult task of translating a metaphysical German work into good English, are not the most competent judges of the manner of its execution. It is one thing to understand the ideas of a foreign author, and quite another to convey precisely those ideas to others through the medium of a totally different language. It has been my study and aim to give the author's ideas as literally as possible, and in some instances, perhaps, I have erred in this respect; but a slight want of perspicuity, or even an apparent solecism, I have deemed a more venial fault than a contortion of the sense, or the concealment of the ideas of the author by a graceful English drapery. I think it will be considered as one merit, at least, in this translation, that there is not a sentence in the original which is omitted in the English version. I have not taken the too customary liberty of anglicising only what was easy and intelligible, or of introducing my own views or opinions, but have given the reader what I believe to be a faithful transcript of every idea and every sentence of the author, as far as such can be obtained without an acquaintance with the German work.

The present volume embraces the whole subject of General Pathology, and has already been through two successive editions in Germany. The first edition was published in 1846, in Braunschweig. The author has styled the whole work "Manual of

Rational Pathology"—using the word "rational" as opposed to "empirical;" but, as we do not commonly make so nice distinctions in our medical technology, and as the use of the word might be misunderstood, or give rise to the idea that there is an "irrational" pathology, I have dropped the term "rational," and leave the text to explain itself. This volume is succeeded by two more extensive ones, devoted to the consideration of Special Pathology, and illustrated by plates, which I am now engaged in translating, and which I intend to offer to the public, if the present work meets with sufficient encouragement to warrant the expense.

In conclusion, allow me to remind the reader, by way of further apology for any errors he may discover, that I commenced the translation of this work, about a year since, solely for my own amusement and instruction, and that I have been induced to publish it only at the solicitation of numerous professional friends, who have lent me kind and generous assistance. The labor of transcribing it for the press has necessarily been done in the evening hours, after the oftentimes fatiguing duties of the day; and consequently, if errors have occurred, it is not to be wondered at: but if it shall prove to others who may peruse these pages, a source of as much relaxation and profit as it has been to me in many a midnight hour, stolen from the routine duties of a toilsome and time-absorbing profession, I shall be satisfied that my labors have not been wholly in vain.

HENRY C. PRESTON.

PROVIDENCE, May, 1853.

AUTHOR'S PREFACE.

With this volume, I commence the fulfilment of a promise which I made implicitly more than six years ago, concerning my pathological investigations, and to which (with pleasure I confess it) since that time I have often, and from many quarters, been urged.

This is an attempt to collect together into the same form, those physiological facts which the observations of diseased bodies have brought to light, together with the theories and hypotheses pertaining to them, which the systematic German mind demands, in order to point out their place in the embryonic history of the science.

My first duty, I had thought, should be to introduce them to the Profession with an apology for their theoretic tendency. This, however, at the present day is unnecessary. It is the prevailing conviction that, as the old empirical, eclectic system of Medicine, against which we are struggling, is founded upon various hypotheses, so its foundation is the more insecure, the less its fundamental principles are connected, and the less it was considered, in the building up of the system, how much it would be able to support. The Science of Medicine is now aroused to such a degree of self-consciousness, that she has no superiority over other empirical knowledge; that she cannot take a step in advance, which she has not first marked out by an hypothesis. And this is well; for the day of the last hypothesis would be also the day of the last observation. For what other purpose do we collect experiences, than to support an opinion at the

time not established? Who takes the trouble to observe whether or not the sun rises in the east, or whether water runs down hill? I admit that here is a point at which Science and Art separate. Science, which has itself for its object, rejoices in an endless, limitless labor; where, over every summit it has gained, still another peak arises: Art demands a positive, circumscribed material, in order to abstract from it certain and immutable rules. The same thing that Science would prefer to lay on one side as settled, Art would appropriate to itself, and apply it to its own practical use. But, in Medicine, it would seem as if special care had been taken that the theorist should dispose of nothing so easily, and that practical men should not become mere artists.

But while we are inclined to award to hypothesis in general its rights, we will not censure the volatility of the individual and special, which are springing up in our domain. It is thought necessary to deny them sympathy, on account of their ephemeral existence: verily we impute to them the fault of rashness, and consider their untimely end as a proof of their premature birth. This is not always just. Whether an embryonic epoch may be necessary or not, we should not judge them by the permanence of their duration. Their speedy termination, on the contrary, would rather prognosticate favorably, being evidence of an energetic vital process. An hypothesis which becomes dispossessed by new facts, dies an honorable death; and if it has already called up for examination those truths by which it is annihilated, it deserves a monument of gratitude.

The number of those physicians is still very considerable, who think they must wait, with an apparent benevolent glance at the agitated elements of the present time, until out of them a solid nucleus, which promises to be permanent, is formed, and meantime remain satisfied with their now existing, even though riddled theories. To such, allow me to propose the following parable:— A pedant for a long time had a nightingale, which gladdened him with its song. The animal died. The pedant, finding quiet and solitude disagreeable, went out to buy another bird. But there were only a few nests brought to market. The merchant

knew not certainly that the eggs were fructified, and, at all events, would not warrant them to produce males; even when hatched, they would require considerable attention and training before they would become singers. To the pedant this appeared hazardous; and he went home, saying he would rather keep his dead nightingale. This was acting conservatively; but was it judicious? That the trouble of raising the young brood might be lost, was possible; but that the dead nightingale would never sing—was certain.

THE AUTHOR.

A TREATISE

ON

GENERAL PATHOLOGY.

INTRODUCTION.

I. MEDICAL SYSTEMS.

The duty of the Physician is to prevent and to cure diseases. Instinct, accident, and experience have taught us that certain extraneous influences, as they change the condition of the healthy body, can also become useful in restoring the diseased body to its normal state. The physician must diagnose the nature of the disease, and after that, define in particular, those external influences which may become remedies.

It has been a subject of long controversy to determine what law should guide him in this labor. Two systems contend for the superiority, which we must compare more carefully than has ever been done, and which we must separate more rigidly than has ever been possible in practice, in order to know the value of each, and to establish peace between the champions of both sides.

The condition of the diseased, as of the healthy body, is shown by its effects, by certain external sensible phenomena, which are called symptoms.

Notwithstanding the multiplicity of morbid symptoms is great, it can be readily perceived, that many of them return in certain connexions and successions, and by such an order of symptoms it is empirically established, that they are caused al-

ways or generally by determined external circumstances, and are removed by determined remedies.

One system, by consciously abandoning all investigation into the first cause and the internal connexion of symptoms, describes the form of disease according to the external phenomena: its descriptions furnish only a substitute for sensible impressions: its names are not definitions, but only *nomina propria*, and are so much the more welcome the less a definite idea attaches to them: and should it need a word, for example, inflammation, it designates thereby nothing but the association of "redness, heat, tumefaction, and pain."

The adherents of this system concern themselves much less about the *modus operandi* of the cause and of the remedy, than about the origin or first cause of the symptoms. On this account they make use of those remedies which have most frequently exhibited a favorable effect, and if they employ a new one, it is by way of experiment, in case the well-known remedies have proved insufficient, or where a newer substance that promises much is discovered. Thus, the certainty of their different methods of cure, is not determined by internal arguments, but only by the number of medical observations: so all depends on collecting and using the most extended range of experiences. Clinical experience is here the rule of treatment. This system or method is called the Empirical.

The odious additional signification which adheres to it must be at once removed from the name "Empiric," because the usage of language frequently alternates the words empiric and symptomatologist;—the former takes up the symptoms in their connexion; the latter considers the same, but only individually, and thus combats them. The empiric knows that a symptom, as pain, can be relieved by means of opium; but he also knows that opium does not, or at least not permanently, relieve, if the pain comes on simultaneously with redness and tumefaction. The symptomatologist knows only pain and opium.

The second system, which has been called the Theoretical, Physiological, or Rational, endeavors to take up the symptoms in their dependence upon each other, and in their connexion with

internal changes, and considers these changes as the consequences of external influences upon the organic matter which is endowed with its own inherent vital powers. The causes which it thinks it has discovered as the occasion of the symptoms, this system substitutes for the symptoms, where it describes diseases; it loves to note the exact direction which the operation of morbid changes takes and exchanges, for instance, the name "Inflammation," (according to the prevailing ideas with regard to this disease,) for such names as "increased plasticity," "hyperæmia," "stasis," and others. Again—theoretical medicine searches after the absolute power and nature of the remedy, and after the so-called physiological effect, that is, the mode and manner by which the substance and vital power of the organism is altered. It argues according to reason, that the effects, namely, the symptoms, cannot otherwise be obviated than by the removal of the cause, and further, that in order to change any certain condition, its opposite must be supposed. From the knowledge of the condition which lies at the foundation of morbid symptoms, arises the indication, that is, the determining as to what may be done in order to restore again the normal condition; and according to the knowledge which we have of the *modus operandi* of the remedies, we must select that which answers to the indication.

The diagnosis of the empiric, like the diagnosis in the descriptive natural sciences, proves nothing else than that the individual case, according to its external signs, follows this or that series of cases; the diagnosis of the theorist is the concise and self-sustaining history of the individual case. To the empirical physician a definite, sensibly perceptible group of symptoms indicates indirectly a determined, specific manner of cure; to the theoretical physician, by a presupposed internal disturbance is indicated immediately, only the internal change which is to be effected, and then also directly the manner by which he supposes the desired effect will be produced.

Were we obliged to choose between the two systems, the Empirical and the Rational, we must confess that the former, according to its principles, promises the most safety; because, by comparing merely sensible appearances, and collecting the opi-

nions for and against, we are less easily led into error than by a process of reasoning, where conclusion is built out of conclusion, and one weak link in the chain may render the whole useless. He who knows the history of our science and the controversies of our times only superficially—yea, verily, the whole public itself—is convinced of the fallibility and inconstancy of artificial theories. On the contrary, the experience that Cinchona has cured intermittent fever stands so firm, shows so much security, that it is entirely indifferent how we explain the nature of intermittent fever, or the mode of operation of the Cinchona. Had the Empirical medical art many such results to show, reflection and inquiry would be wholly unnecessary to the honest physician; and we would reproach him for it, as perhaps, by way of incentive to exertion, we would point the artist who allows his hands to remain idle, while speculating upon the principles of his own creations, to the honest simplicity of the great masters. But incontestable and undisputed remedial prescriptions belong to the rarities. With a material of experience collected during two thousand years, we still see the leaders (*koryphäen*) of the art despairing of all influence of medicines, and others in homogeneous cases taking diametrically opposite ways. After two thousand years of instruction, the Medical Profession has not yet acquired so strong a hold that every self-conceited charlatan cannot, for a time at least, figure as a reformer. We possess a Therapeia which recommends for each disease its remedy, a Materia Medica which also recommends each remedy for each disease, and still we can hardly agree upon the diagnostic characters of the most important diseases.

It would certainly have been better for Empirical Medicine had it from the beginning pursued its aim with a determined consciousness of its task. But if we confess how few medical experiences, made at the present day, are safe, pure, and applicable, we are obliged, if the knowledge acquired has become useless, to search for the causes which have complicated that experience.

The causes are partly subjective and therefore general, partly objective, that is, dependent upon the peculiarities of the objects of medical science.

That which renders pure experimental knowledge so intrinsically difficult, is first, the inclination or disposition to explain, which is natural to our minds; an inclination which we cannot farther illustrate here, but which will be perceived in its phenomena and effects. It is that inclination which forces us to put in the relation of causes to each other, those facts which we see succeeding each other in inseparable connexion, and under the head of sensible effects, a multitude of supernatural causes. The more inadequate our knowledge of facts is, so much shorter appears the chain of material effects agreeing with each other; so much deeper do we allow immaterial causes to exert influence in the world of sense; and so much more specific and polymorphean are the operations which we impute to it. It resembles and will be compared, tacitly or confessedly, with the immaterial principle, which, under the garb of the will, determines the actions of our bodies. As man and mankind acted formerly more passionately than rationally, so the operating spirit in creation was supposed to be governed formerly more by affection than by reason. And as the cause and design frequently are merged in the intelligent motives of our actions, so in our reflections upon the material world a penetration into the design is considered the cause of events. But this teleological stand-point is doubly dangerous, because if one dares to guess the fundamental design of an event, he makes, not only the everlasting form of human thought, but also the accidental contents of the same, that is, his stored-up knowledge, as the rule of his judgment. Pope denotes this when he makes the fattened goose cry out, "See! man was created for my use!"

In the beginning of all science, therefore, experience and theory are so much the more intimately connected with each other, the easier and more conveniently they are brought in contact. They agree so much better, the more distant and undetermined is the theory, and the more unsubstantial and more pliant is experience. Subsequently criticism steps in to separate observation and speculation. Criticism has a positive and a negative course. In the first place, it rejects the theory which has contradicted its observation; in the second place, it makes the theory itself, as

an empirical fact, the subject of its observations, and afterwards shows its necessity.

The first theory, the first science, is religion. It expresses itself in a popular manner and tradition concerning the first cause of all created things. What it acknowledges as such, produces reverential regard for designs comprehensible to man, and influences him in his operations with human arbitrariness. Its God creates the world out of love, he destroys it for vengeance; he pardons and punishes, elects and rejects. He led forth the sun, that it might light us, he formed animals and plants, that man might subsist on them, and man that he might not want a sympathizing being. He demands of his world, if not more material enjoyment, still gratitude and acknowledgment. Death and disease also are his works—the wounds of his darts, the blows of his hammer, the bites of his snakes. They are not only the consequences of transgression, but its punishment, or the physical means of education, inflicted on his children from a fatherly hand. The priests are physicians, not because they are learned, but because they stand in intimate connexion with the anthropomorphite *causa proxima* of disease. Even the people had adopted the theoretical medicine, when they gave their confidence to those who pretended to know the causes of suffering, and possess the remedy for removing those causes.

Meanwhile, the continuance, order, and regularity with which the phenomena of the material world are repeated, cannot long escape an observer. As he sees the wheels of creation once set in motion like the works of a watch, to run down, and to act upon one another, so it appears to him the Creator has withdrawn his immediate influence, and only in cases of exception, by means of miracles, has to use his absolute almighty power. As the rule we may adopt, that the causes of material effects are necessarily and invariably connected as forces to matter. God is metamorphosed into the cause of causes; he becomes the supreme cause, who brought together the matter and forces with goodness and wisdom, no matter in what way. His hand moves no more, but simply sets the forces in motion. But his attributes, which are benevolent and full of design, are transmitted to the forces which

supply his place. Was it not so of old? Did not natural philosophy apologize for the ascent of fluidity because Nature abhorred a vacuum?

At this period of philosophical religious contemplation was the beginning of physiological pathology. Teleology finds nowhere a more fertile soil; nowhere has it struck deeper roots. In all its transparent connexions there appeared such a delicate calculation of the remedy in the organism, that they felt urged to search out in difficult cases its secret design. So arises the natural orthodox pathology, which we might superscribe "*de usu symptomatum*," with the same justice that physiology has been called the "*doctrinam de usu partium*;" and there appeared those medical theorists who admired instead of reasoning, who praised the exquisite contrivances of a very wise Nature, and, notwithstanding, in intellectual pride, proclaimed how this Nature may be capable of serious errors without the careful guidance of physicians. Here is not the place to examine whether and how far teleological contemplation may be necessary to investigations in the domain of the organic world; it is the place only to show that it has been smuggled in unknown, and therefore without the necessary consistency, in a worthless form of the subject, and that, with the tenacity of experience, it has overruled preconceived opinions.

As every religious, so every medical theory also begins with a personal *dualism*, in order to explain the contradictions of favorable and pernicious events. The devil of medicine is disease, or in more scientific language, the morbid-irritant, the *materia peccans*, the penetrating noxiousness, the morbid organism. Between the medical and the theological devil, according to biblical notices and old-wives' fables, there exists not a mere analogy but a complete identity: the delirious ravings of the possessed are the language of the evil spirit who possesses. But the two differ in their history of development in that, whilst the theological devil gradually loses his tail and claws, and dissolves into thin air, the medical devil or the disease gains, in modern times, a definite figure, invested with organs and even with genitals, by which, like a parasite, it shall dwell and even reproduce on the diseased

body. The angel of medicine is the autocracy or sanative power of nature, or reaction. Angel and devil strive with each other for the possession of the poor soul, which is here, the body—in other words, disease and reaction contend in battle with each other. The image of disease is composed from the demonstrations of battle. According as the symptoms indicate a struggle and are accustomed to lead on to a favorable termination, or according as they announce lethargy, destruction, and death, they come to be considered disease or reaction. The angel causes the critical molimina, and endeavors to expel its antagonist or his mortal remains through some of the natural openings of the body. This is frequently a failure, and hence arises another essential difference between the theological and the medical mythos. Failures are imputed to the devil, who carries away the soul; the people represent him, for their consolation, as a stupid devil whom the good genius conquers by cunning. But the devil who carries away the body, accomplishes his design only too apparently; the physician represents him, by way of apology, as a crafty monster who knows how to take possession, in case of apparent necessity to yield his ground, and to break out with violence in some other situation, and especially allows not himself willingly to come forth upon the skin openly and honestly. In medicine, the angel is the stupid one, and the one who is cheated, who loses the favorable opportunity by slumbering, now does too much, now too little, and injures the body it should protect by his awkward management, and lastly makes the pseudo-crisis of Schönlein, that is, instead of expelling the wicked fiend, he drives him into an internal cavity, where he rages with unbounded fury. To that angel was attributed a part similar to the mediating influence of a patron saint, when the pain which he excites by contest with the evil noxious spirit, was called a disposition by which he summoned the whole united organism as a superior court to inspect and to interfere.

These views owe their origin not only to the theories of Hippocrates, Galen, Helmont, Stahl, and, as has been remarked, to the so-called natural historical school, but the fundamental doctrine of a physiology, even now adopted in the most extended circles, is

also only a paraphrase of the same. Because, if we define the activity which ensues from irritation, as an indication of the effort of the organism to maintain its own condition in opposition to external inimical invasions, then is not each actual effect explained as a *molimen criticum*, produced by the autocracy of the organism, and having, as its object, the removal of the enemy? Instead of the causes of irritation, which we are authorized to infer from the coincident facts, do we not demand the designs of the same, which God himself could only have disclosed to us in some unguarded moment? Between the cause (irritation) and the effect (excitement), do we not insinuate a free controlling power, which acts peradventure with the most excellent intention, but with most absurd choice of means; if it defends itself against a galvanic current with a convulsion or a saltish taste, against a series of aerial vibrations with a melody, against a blow upon the eyes with a vivid flash like lightning?

But the negative critics hitherto have not been strong enough to shake the belief in this tradition. They effected only a reformation by re-establishing in its purity the hippocratic revelation, purged of the scholastic alchymic disfigurations of the middle ages. And as the rules derived from fundamental truths, with the experiences and with the directions sanctioned by practice, seemed to result in unsolvable contradictions, there sprang up, under the name *Eclectic*, those representatives of empty elucidation, of the *juste milieu*, of the medium of extremes. The breach between theory and practice, which they feared, was avoided or postponed, if in regard to theory, the pretension was abandoned to penetrate into particulars, and if practice acknowledged that it was excluded from counsel on account of juvenile immaturity, and had only to progress in silence and hope. The contest was settled and tranquillity procured, not through a reconciliation of the parties, but in that they agreed to separate. The so-called impartial examination of facts should lead to a medium between the two. They believed they had principles, and withdrew from their application; they proclaimed themselves free, and yet held fast to the consequences of old dogmas; they exercised tolerance, not because they embraced the truth of each dogma, but because

a chasm opened between theory and life, beyond which theory appeared indifferently. They became philosophers when they exchanged the concrete poetical veil of tradition for a vesture woven out of rambling flourishes of living and vanished philosophical systems. This stand-point is marked out in Hufeland's *Enchiridium medicum*, as Tschokke has marked out the corresponding Christian stand-point by its hours of devotion.

True freedom can only be established by that criticism which I have called positive, and which shows how the natural man sees and exhibits only his own image in a glass, where he thought, through the waves of practical life, to see to the bottom;—criticism which, whilst it examines the substance of knowledge, equally fathoms its sources. In this respect I consider it more than an accidental coincidence that the foregoing considerations, with regard to the mythos of medicine, make themselves apparent only now, at a time when we have learned to recognise the historical forms of religion and of political economy, as the impress and degree of development of one human intellect.

Each science, and particularly ours, has experienced how precipitate explanations, by the appearance of insight and the delusive tranquillity which they afford, frustrate the true progress of theory. But we will not go into this subject; we here only accuse medical superstition in so far as it has corrupted observation, shown sensible phantoms, in false colors, created practical measures, and maintained or prevented reasonable reform. We mention here the sought and made *crises*, the retroceded and expelled *perspirations*, the hardened, displaced, and dissolved *mucus*, the stimulant *remedies* which have supported nature in her restorative efforts, the heating *applications* which have been used to draw out herpetic eruptions, and lastly, the dread of the absorbed poisonous *virus*, which has opposed the multifariously-approved treatment of the itch and syphilis.

But experience has indeed become master of the grossest and most pernicious errors, although not until after long and painful contests: other errors remain, if not defended, still preserved. With conservative indolence and self-complacence, the so-called Empirics repel every attack upon the venerable doctrine of crises,

referring to clinical observations. And notwithstanding this, observation can have taught neither the cause nor the object of a crisis, and in general, nothing else than that acute diseases are accustomed to terminate with signs of general excitement, and at the same time with different kinds of excretions.

A second not less original, not less obtrusive inclination of our minds, which just as precipitately and unconsciously influences our actions, and according to circumstances is just so misrepresented, suppressed, or mixed up with inventions, is the inclination to synthesis, a passion to regulate according to simple numerical proportions the whole domain of knowledge and the circle of harmonic ideas, beginning from a unity as a base. This passion creates systems, and the systems give satisfaction in that they embrace facts which otherwise lay in immeasurable expansion before us, and comprehends them in a circumscribed and symmetrical form; but they do harm, because the form is at the same time pedantic. As the mythos is prejudicial to the profundity, so is the system to the latitude of experience: the former bribes with a superficial, the latter with an artificially polished knowledge; the one deceives us with regard to the foundation, the other with the variety of appearances. It was owing to a philosophical system that the number of elements of inanimate nature and of the human body, was established as four, and still remain so; and although at last chemistry succeeded in analyzing those elements, still medicine possesses besides the well-known four temperaments, many other things which date from the time of that tetrarchy. Again, at a later period, a philosophical system, which regarded the number 3 sacred, created the diseases of "sensibility," "irritability," and "reproduction," and prevented its adherents from perceiving in how intimate relations the activity of the nerves, the tone of the circulation, and the energy of the secretions stand to each other.

The mania to reduce the totality of symptoms to differences in quantity, depends upon the same cause as the passion for systems in general. The elements or humors, forces or organs, which are considered as the constituent parts of the healthy body, can change; but the idea that the equilibrium of these factors being

destroyed, or a predominance of the one or the other, is the condition of disease, remains constant. This propensity, which is familiar to medical systems, deserves so much more to be rendered conspicuous, the more agreeably that principle of explanation has presented itself from the beginning, and the less its admissibility in general has been doubted. Still, at the present day, is every theory sure of instantaneous success which the pathological process diverts from a hypothetical or real increase of any one of the constituent ingredients of the blood.

In addition to the here described sources of error, we must remember those where, in any manner, the age and the number of experiences shall become useful as an argument. They might, to their mortification, be put in parallel with conceited empiricism if they should thoughtlessly refer to their pedigree; but they are quite as well suited to appease the despair which would seize us when we compare the expenses of time, labor, and material with the practical results. Centuries have passed away during which facts appeared in a false light or entirely worthless, and were neglected; practical talents were not regarded, poetical and rhetorical talents received encouragement without true vocation; each important discovery rashly applied must be atoned for by a long train of not always instructive mistakes. Taught wisdom by experience, as we are, and even after having explicitly marked out for us the course of the true empiric, should we not be able to banish each uncalled-for reflection, to compare the true and unimportant symptoms, to record the results of treatment, and thus at least from henceforth to make of medicine, so far as it has not yet been done, a science of experience!

This is, as is well known, the endeavor of the new French school, of which Louis is the head. Rejecting unsafe traditions, and acquainted with the deceptions which naturally result from the grouping of symptoms, and the results of treatment according to a trifling number of cases, and a superficial recollection, Louis demands that the value, as well of the symptoms as of the method of cure, should be expressed in numbers, which are to be obtained by means of a comparison of the utmost extended series of observations, exactly and accurately noted down.

In fact this method, which has been called the numerical or statistical, is the only one from the application of which empirical medicine can expect advantage, as it is generally in empirical sciences the only one admissible, in truth the only one possible. Thence it happens that logical certainties are never derived from the decisions of experience, but only a greater or lesser degree of probability, which is regulated according to the number of observations, and according to the connexions of those corroborating to those opposing. The so-called laws of nature have only the highest degree of probability. As far as credible evidence extends no man has escaped death; so we consider, with the highest degree of probability, that mortality is a necessary and general attribute of each individual, and we foretell with the greatest confidence to each one living that this lot will fall to him. A not less important mass of facts authorizes the decision that a corpse, in which corruption has once commenced, will never again be awakened to life; but we have no means of proving this point logically: it must be tolerated if it is asserted that exceptions have occurred, and at best the more numerous the proofs for the law, the more scrupulous must we be in proving the testimonials for the exceptions.

In other cases the objections are too well sustained to be denied. The fact asserted loses therefore its probability; it remains no longer a law, but a rule or normal condition; but the worth of such a rule is variable, and numerically expressed by the proportion of the affirmative to the negative cases. Such expressions demand statistics. Still we may dispense with the exact effect of the calculation, when the most superficial glance and one trial of each decides the scarcity of the exceptions (notwithstanding even for this case a mathematical expression is not to be despised). No one, for instance, would undertake to prove logically that the situation of the nose between and under the eyes must be the normal position; this would be to demand a comparative calculation of the monstrosities (*cyclopischen*) and the well-formed bodies. But if a controversy is commenced in respect to two facts contradicting each other, and reciprocally seceding from each other, then no alternative is left but in statistics. The greater becomes

the range of experience, the more increases the confidence in the result, and so the one alternative vanishes when it is really only an exception to the other.

In practical medicine, most points unquestionably belong to the disputable. There are few laws: the rules are seldom firmly established, and even when they are so, are of uncertain value. We must allow that in similar cases under one species of associated cases of disease, a certain symptom may be at one time present, at another time absent; that certain phenomena often lead the way to a fatal, but sometimes to a favorable termination, &c.; so that we cannot avoid the disposition to correct such superficial opinions by statistical records.

But calculations of this kind are entitled to no farther authority than the declaration that facts stand in a legitimate or regular order; they inform us not of internal connexions. That such connexion exists, and in what form, only the theorizing mind in every place declares or supposes. Pure empirical knowledge therefore designedly withholds an opinion upon this point, and so also pure empirical pathology eludes it. It knows that ulceration of the bowels and typhus fever, enlargement of the spleen and intermittent fever, an increase in the fibrine of the blood, and the local signs of inflammation, belong together; but it guards against, or would rather avoid speaking of the relations of cause of each anatomical change to the symptoms of the disease. It leaves each one, according to the more usual mode of expression, to consider the intestinal ulceration as the cause or as the effect of the disease. But if one scientific fact has arrived at a practical application, even though so empirically acquired, then does it entirely exclude all inquiry after the causes. As unscientific as it would be always to pass over the symptoms of disease and recovery without supposing some relation of cause, so is, at least, the arbitrary therapeutic interference not at all imaginable without the presupposition, that in corresponding cases a method of cure and the subsidence of the disease had stood in a certain determined causal relation.

Even upon this ground it is a delusion to imagine that in medicine we can always stand upon pure empirical ground. That

single unavoidable conclusion is a source of logical errors, the deceptive "*post hoc, ergo propter hoc,*" whereof, as is well known, the champions of opposing systems have never neglected to remind each other. From that single conclusion each medicinal experience becomes an hypothesis in so far as it may be restrictive; because we learn only that treatment and recovery follow each other, it is inferred and hypothetical, that recovery will be the effect of the treatment. Old as this observation is, it is necessary that it be renewed: because man repeatedly forgets it and overloads himself with medicines, which neither possess the power to cure nor to injure. The rule may be laid down that a number of acute diseases can be cured with *Sal ammoniac, Spir. mindereri, Roob. sambuci;* but it remains an hypothesis, that the cure results from these medicaments. We have, therefore, practical facts to examine, not according to the scale of measurement by which we estimate normal sensible symptoms, but according to the measure by which we estimate hypotheses in their internal connexion.

The genuine test-stone for such hypothesis is experiment. If we suppose two facts in the relation of cause to each other, then we presuppose or assume, with a certain liberty of conscience, that the one may appear as the cause; but the other, the effect, appears of necessity every time and as soon as the cause shall be presented. A trial is for this reason so valuable, because it expresses this relation in the most perfect manner, and most decisively makes it known. By means of this trial the most free and arbitrary thing that we know, namely, our own will, determines the cause or annihilates it, and awaits the appearance or the non-appearance of the effect; it establishes or annihilates that cause as often as the doubt may arise, whether, perhaps, the coincidence might have been an accidental one, and the consequence for once from another source.

Again: it is the number of observations that determines the degree of probability with which we derive a certain effect from a certain cause, and are able to foretell the same effects in future from the same causes. But the problem becomes more complicated when many, and particularly opposite conditions, partici-

pate in the same result. If the influence of one single cause should be ascertained experimentally, then must the rest be excluded, or if this is impossible, must be rendered conformable to each other. If this succeeds entirely, then must the effect of the one cause be continually the same as that yielded by the examination. If this is not continually the same, then it proves either that the connexion between the presumed cause and its effect is not necessary, but accidental, or that the presumption that the other causes were completely harmonized, was an erroneous one. If we decide in favor of the latter alternative, in order not to conclude rashly, and at the same time, freely, or constrained by the force of circumstances, renounce all further accommodation (*rivelliren*): then arises the case, where we must be content with a relative estimate of the desired worth of the causes, and with comparative statements concerning their intensity. We consider then the inextricable medley of all the other causes as one single quantity, and study the modifications which it undergoes by the addition of the one cause. Disease, death, and recovery are such compounded facts, complicated with external morbific influences, with the reactive conditions of the organism and of the treatment. If we would know the value of one of these momenta, for instance, of a certain method of cure, it would not be sufficient to reckon those cases in which it was tried with or without success; but the sum of recoveries obtained by it must be specified in connexion with those cases where it was not applied, or where another method was used. Medical statistics demand this, and if we explain, with the rigorous Empirics, a part of the causes of disease and of recovery, namely, the physiological energies of the organism as primarily unfathomable, still we cannot comprehend by what way a decision can be obtained, except by that just now marked out. I repeat: for an earnest-minded Empiric there is no other way; the statistical or numerical system and the empirical are one—the latter is as little a variation of the former as the mature intelligent man is a variation of the artless inconsiderate boy. It is another question, certainly, what the numerical method has accomplished and can accomplish for practice; this we will endeavor to ascertain more closely immediately. But where it is

not able to direct the choice of remedies, merely the so-called experience is still less able; unless we assert that the eyesight is more proper than measuring instruments, to discover difference of magnitude.

The statistical method is not applicable where a considerable number of comparable cases is not at command. It is not suitable for rare diseases, nor for those whose course presents great fluctuation; still less for the not trifling number of chronic diseases, which belong rightly to no one of the well-known families, and therefore are excluded from the sphere of our systems. Its appropriate field is acute, and particularly the endemic or epidemic diseases, where the diagnosis is easy and certain, the influence of single conditions is unimportant, and is governed by the general causes of disease. Extensive epidemics on that account have always favored the reception of the empirical system at the expense of theories valuable at the time. But the statistical method has not once passed through even this limited department without restrictions. Acute diseases, which we cannot avoid associating under a specific character, according to our present knowledge, appear with a very different character according to place and time, and it is precarious, if not injurious, to transfer experiences accumulated in certain countries and years to others. Acute diseases, which we now separate specifically, were formerly associated under one appellation, and in the same manner, perhaps, will a coming generation analyze our species. But with each division of this kind, the hitherto acquired material becomes worthless, and we roll the "stone of Sisyphus," if with great pains we record the results of a treatment, and yet see the object of treatment arrived at its zenith, vanish before us. But allow that the identity of comparable cases of disease is firmly established, how many new difficulties oppose themselves to a uniform operation of the remedies!—A steadfast obedience and indefatigable watching over the patient, a dauntless self-confidence of the physician, an exactly regulated order of all external conditions are necessary, if the therapeutic trial would claim the name and the value of a physiological experiment. In this respect, some, who were as well acquainted with the value as with the

errors of medical statistics, wished to base their calculations upon no other than the experience of hospital practice. And here for once, we are obliged to mention the personality of the observer, and allow that those dangers are not yet suppressed, which, on this side, threaten empirical medicine more than any other empirical science. The less, on the one hand, as control is dreaded in medicine, the more brilliant, on the other, will be the temporary reward of those who know how to emerge from the multitude, and so much the nearer lies the danger, that not only self-conceited superficiality, but also the more genuine, commoner deception will smuggle in those facts which will misdirect the progress of its successors.

But when finally, numerical medicine has arrived at authentic and invariable results, in that class of cases to which it must be restricted, through a favorable correspondence of all objective and subjective circumstances, then still may the opinion always be raised against the practical usefulness of this result. What have we to do, if the comparison of two methods of cure gives for the one an indifferent, or even an important decision? Shall we adopt it therefore for all cases, and therein resign ourselves for the future to sacrifice a certain number of patients? Would not those whom we now abandon as incurable, perhaps have been saved by a treatment with which the great majority of physicians do not agree? Do we console ourselves, like gamblers, with the prospect that in the end the gain will surmount the loss? But even if the comparable diseases are great, the individualities are not. Only upon the field of slaughter are fifty living men, an equivalent for fifty dead: to the physician, no one will deny, each personality is incommensurable. We can only discharge the duties which originate in this condition, as is well known, by the rule of individualization. But he who individualizes, theorizes. The stamp of individuality, in contradistinction to that of the species, is that coincidence of phenomena conditioned by a multiplicity of disturbing and promoting causes, and to such a degree conditioned by these that it cannot be foretold, and its repetition is hardly ever to be expected; therefore it can give, for that individuality, neither advice nor rule: here is the field

of analogy—of combination—of abstraction—that is, the separation of the accidental from the essential, and the critical examination of the signification of each accident. The faculty which enables the physician to individualize, is called tact, and with entire justice, because what is called tact in society, is the ability, in dilemmas where reputation or convenience do not consist in thorough precepts of right, to conduct one's self with consideration mixed with judicious pretension. But tact cannot be taught, it is even not inborn—only the talent to acquire it is inborn. It is not acquired without reflection; the treatment which displays great tact, differs from that which is based upon conscious, mental reflection, only by the practically acquired velocity, with which it runs through a range of ideas, weighs contradictions, and makes use of slight indicia; he who has no tact, learns more slowly, and after a longer time, by experience and studied reflection, what is to be done, and what to be omitted. But with respect to practical tact, it belongs only to the matured physician—the younger can only acquire it upon the above-mentioned way, and not without hard labor. If they think to escape by a cheaper bargain, then they turn, and accept a substitute for which our language, has borrowed a French appellation to which it joins a despicable accessory meaning—they acquire *routine*, that is a facility of behaviour, which rests not upon a survey of relations, but upon a total disregard of them.

We conclude—that as pure empiricism is not sufficient for all cases, and only in a very few can be our sole therapeutic guide: as we cannot help proceeding, in particular cases, according to particular reflections, which can only arise from our views of the importance of the symptoms and the nature of the remedy: so it is our duty to search as deeply as possible into the nature, and internal connexion of the phenomena in which we shall interfere. He who is once obliged to theorize acts foolishly, and in case he assumes responsibility, he acts without principle, and if he leaves it to accident what theory shall answer his purpose in any critical moment.

I think I have demonstrated in the foregoing, why there is a rigid separation of the empirical and the rational systems, which,

as I remarked in the beginning, cannot be carried out in reality. The rude characteristic of both, which we have sketched, suffices to show in how intimate and indissoluble a connexion they stand, and we demand only what both parties tacitly, and even contrary to their expressed assurance, have already accomplished, when we expect every one to be at the same time empiric and theorist. Therefore, should not only the mutual deficiencies of empirical and theoretical medicine be supplied, but both should be reciprocally promoted, where they can be simultaneously applied. Now, first of all, the question arises how this connexion may be effected: and in order to answer this, a more accurate consideration of the sources and means of both systems, becomes necessary.

II. MEDICAL DISCIPLINES—THE POSITION OF RATIONAL PATHOLOGY.

Medical science at all times has been a medley of empirically acquired facts and theoretical observations, and so it is likely to remain. The proficiency to which the knowledge of this position should lead, is first of all a consciousness of the boundaries of empiricism and of theory, in order that we may distinguish what is thought of the one or the other, and where we have to appeal to the one or the other. In the school, which has to transmit the collected material of medical science, the problem arises, to teach theoretical and empirical medicine; but to consider both from the beginning as much as possible separately, and only to infer from the former the manner of combination of the latter, which the actual condition of both systems allows, and practical necessity demands.

An indistinct recognition of this demand, a long time ago, led to a division of medicine into different disciplines, which I shall adopt, and which I shall define according to the stand-point above established.

Medical science, abstracted from the division of diseases into internal and external, may be arranged under three groups:—the first embraces what we know of disease, and of its dif-

ferent forms;—the second comprehends the doctrine of the remedies—the third, the rules concerning the administration of these remedies. We comprehend the contents of the first group under the name doctrine of disease—pathology; the contents of the second under the name doctrine of remedies—materia medica, pharmacology; those of the third, under the name doctrine of cure—therapeia. Pathology, pharmacology, and therapeia, are differently treated of, according as they are taught in behalf of the empirical or the theoretical system. The only neutral and preparatory knowledge for both systems, is anatomy, which describes the object, whose changes must be either recorded or explained.

In proportion as the empirical physician regards pathology, so he requires a more faithful delineation of the forms of disease, according to its symptoms and their course, in order that he may thereby distinguish them from others. To provide such delineations, is the proposition of special pathology, which on that account we are also accustomed to call empirical. Tacitly, or confessedly, it considers the corresponding cases of disease as individuals, associates together those that are similar in the collective form (*gesammtbild*) of genus, divides the genus into species and varieties, &c., and thus analytically obtains a system, which, like that of the descriptive natural sciences, has represented the sum total of individualities in a complete group. Inasmuch as the genera are divided into higher, more comprehensive divisions, we intend, in the first place, to review their general characters, and to facilitate their descriptions, as well as their discoveries: in this respect, the arrangement of the matter, and the principle of classification is tolerably unimportant. But as the system of special pathology, as will be hereafter discussed, plays an important part in the combination of the empirical and the theoretical methods, so must we consider the fundamental principles whereupon the system is constructed and made sure, that they may be applied to each other in each division of the classified forms, and also in their internal substance.

In the descriptive natural sciences, as is known, the systematist can proceed according to two different principles: he provides

either artificial or natural systems. In the former, the bodies are grouped according to a single external characteristic—as plants according to the number of stamens; animals according to the number of extremities; in the natural system, the affinities should be estimated according to the totality of organic relations. Were a single characteristic here necessary to the discrimination, then we must be convinced that it holds an essential connexion to the whole internal construction of a group. Such a characteristic is, for instance, the structure of the teeth in the mammalia; but it is not so with fishes, where the teeth may be different in two sexes of the same species. A multitude of similar facts has led to the conviction, that no single characteristic has the same importance for all the groups of a kingdom: whence it follows that each artificial system must be necessarily also an unnatural one, because it separates affinities, it connects by fortuitous resemblances, those remote from each other, in return for which it presents the advantage of a more simple affinity, and of an easier view. In natural history, at the present time, more than ever, the artificial systems are dispossessed by the natural, and medical science inclines to follow this direction, without a mutual understanding being possible with regard to the claims, which were made to the one or the other mode of classification. An artificial system of diseases cannot, properly speaking, exist, as no criterion exists which could be applied to every disease, or with certain modifications of quantity or quality, could be referred to each individual species. But the circumstances of time form an exception, and accordingly, were in fact formerly and are now, divided into two principal classes, acute and chronic diseases. But that this principle is not applicable to the more remote subdivisions, is very evident. All the other hitherto established systems of diseases, empirical or analytical (I exclude thereby the known and unknown theoretical systems), are natural. They classify diseases according to the prominent symptoms; old and new are distinguished from each other, in that the former has made use of one symptom, the latter of the whole group of symptoms, as a specific character. Classes, such as retentions, profluvia, consumptions, and several

others, embrace a multitude of the most heterogeneous conditions, which have only one, often very unessential symptom in common. The classes in which diseases are included whose similarity is limited to their invasion of one and the same organ, or, which is equivalent, is limited by the alteration of one and the same function, as the exanthemata, neuroses, and others, have the same defects, although in a somewhat less important degree. On the contrary, we have for a long time, already attributed a tolerably well-limited group of diseases to the inflammations, whose essential characteristics are composed of four, the so-called cardinal symptoms. Fevers the same. These are like those families which now par-excellence are denoted as natural families. The more and more definitely modified symptoms are included in the family characteristics, so much more numerous and more restricted become the families, and the more secure are we from unreasonable comparisons. But a system is always to be considered only a temporary one, as long as there remains so much to fathom and to corroborate, in respect to the species which it comprehends.

As a complement to special pathology, in fact as a register to the same, is here to be mentioned the doctrine of signs, semeiology. Special pathology classifies according to the forms of disease, and specifies to each species its own peculiar connexion of symptoms. Semeiology classifies according to the symptoms, and enumerates the species of disease, that is, the connexions in which they appear: it teaches, for example, that semi-lateral headache indicates congestion of the brain, or disease of the frontal bones, or the frontal sinuses, or disturbance of the stomach, or hysteria, &c., the meaning of all which is—headache occurs in cases which are characterized by this and that sign, and these or the material changes.

The *Materia Medica* is to the empirical physician a catalogue of remedies, which are at his command, besides an estimate of their relations to certain forms of disease, or complexes of symptoms admitted into the system. Their effect upon the healthy body is immaterial to him, and at most would only be used as a characteristic for making a group, if the observation accidentally obtruded itself upon him. Thus are found in the pharmacological

systems, the *rubefacientia*, *diuretica*, *laxantia*, *narcotica*, whose denomination is derived from their physiological effects, besides the *roborantia*, *antiscrophulosa*, *anthelmintica*, *febrifuga*, and others, whose names indicate their application in certain morbid conditions. It is a matter of course, that where they have respect to the physiological effect of the remedies, it is meant always only of the symptoms; never of the internal change which occasions them. Therefore it may happen that very different kinds of matter are esteemed in the same manner, and assimilated, when one and the same symptom is proved as the last result of their application. The classes of *diuretica*, *laxantia*, and *emetica*, furnish numerous authentic instances of this.

The therapeia of the empiric is the so-called special therapeia, which, to every diseased structure represented in the special pathology, associates the approved prescriptions for the treatment. Special therapeia bears the same relation to pharmacology, as special pathology to semeiology. Therapeia enumerates the remedies for the diseases, pharmacology the diseases for the remedies.

If we now turn to the corresponding disciplines of rational medicine, and especially to pathology, then we expect from it a statement of the causes and the nature of morbid events. Upon this point judgment has been rendered, either according to the prevailing mythical ideas, or the ideas of free-thinkers, or, in order to arrive analytically at the conception of disease, the common relations of disease, abstracted from their specific symptoms, are summed up together. Thus arose the theory of disease, or the so-called general pathology, in which the special doctrine of causes, together with the known abstractions, and, in consequence of the more recent correction of mistakes, semeiology, were received.

General pathology is only a part, that is, only a general division, of the theoretical. A knowledge of what is common to the different diseases, certainly belongs to an investigation of the nature of disease: but this knowledge is insufficient, and unproductive if it does not rest upon a discernment of the basis of the individual symptoms, and if it proceeds not to the elucidation of the same. Observe how the manuals of general pathology, if

they are deficient in the faith of mythical or philosophical medicine, have subsided into miserable explanatory words,—explanations which either never existed at all, or whose signification is still unexplained by a paraphrase and translation of Greek names. It is for the interest of theoretical pathology to pursue its investigations into individualities: and it is even more for the interest of special pathology to exclude and trample down all that is inferred and hypothetical, concerning the internal connexion of the phenomena of disease. Therefore should special and general pathology, or, as we call them, empirical and rational, differ no more in regard to matter, but in regard to treatment; at best, a division of the material could take place in this manner, that to rational pathology may be especially assigned those processes of disease which have become accessible by a certain detail of illustration, whilst to empirical pathology especially should fall those problematical, for a time unfathomable diseases, which can only be described, not developed.

Our rational pathology is occupied with the vital indications of the diseased body. It has therefore, been called the physiology of disease, or of the diseased body. The first expression is hazardous, because it gives countenance to the thoughtless personification of an idea, and does not immediately repel the suspicion, that we ascribe to the same idea, namely, to the disease, expressions of activity and functions which are, however, nothing else than the altered functions of the diseased organism. The second name is not exposed to this misrepresentation, but it is even less correct; because the physiology of the healthy and of the diseased are not different,—physiology and pathology are one. Physiology is defined as the science which examines the vital powers of the organism, the law of its development, and its conduct towards external influences: but the fact of its being diseased under certain circumstances, is owing to its own reaction against external influences. We may call the destruction of a house, which has been seized by fire, a misfortune; nevertheless, it is a physical phenomenon. We can call the vital process which a morbific influence has called forth, a disease; it is, nevertheless, a physiological phenomenon. From the operation

of such abnormal influences, whereby disease arises, we are able to learn exactly the vital force of the healthy organism. How little should we know about a fossil if we were satisfied with the consideration of its form and color, and with the touch of its surface! In order to know more, we rub it against harder substances, melt it in the fire, and analyze it by means of chemical agents. Something similar is necessary in the study of animate nature. This could have been forgotten only for a short time, as by means of the genetic treatment which a philosophical investigation of nature introduced into our science, whereby an entirely new field opened itself to our investigation. At that time men learned, instead of searching after the design and uses of organs, to inquire after their signification, after the basis of their existence; and this resulted, partly in their development, partly in a comparison of the structures corresponding to each other in the scale of gradation of organisms. Here, as there, it was a unity, which metamorphosed itself, divided itself into different parts, and again united the divided parts to an apparent unity. Thus were obtained physiological explanations, an insight into the plan of organization, a knowledge of what is essential to every compound organ. We must have experienced what pleasure it affords to see the same idea personified in a thousand forms, the most complicated structure developed from the simplest beginning, in order to comprehend, and excuse the zeal with which the leaders (Κορυφαί) in physiology have wandered exclusively in the direction of comparative anatomy. Medicine gained nothing thereby: she obtained nothing but a theory of those hereditary defects of structure, which very seldom become objects of treatment,—the defects of structure owing to arrested development. That physiology now is cured of this partiality; that the forgotten, by many even abandoned, experimental method is again revived to honor, is the consequence, partly of a healthy reaction against the extravagances of philosophical physiologists, partly of more important discoveries in the domain of natural philosophy, of organic chemistry, and even of physiology itself. To the latter belong, before all others, the dogmas of Bell. But as the inclination to experiment returned, physiology became again forced

to an alliance with medicine; the pathology became philosophical, and still more, must I add, the physiology, pathological. The best explanations have originated from the observations of disease, in which the word observation is used in its widest signification, and the apparent must be included with the more imperceptible disturbances of the normal equilibrium. What should we know of the circulation without congestion and inflammation? What of the nerves without convulsion, neuralgia, and paralysis? Does not the little which is known of the functions of single parts of the brain depend principally upon experiences to which injuries, apoplexies, tumors, &c., have given occasion? If we can in this way, make use of diseases as physiological experiments which originate accidentally, so, on the other hand, are the effects of physiological experiments nothing else than gratuitously excited diseases. We cut through or lacerate single parts of the nervous system; we apply the ligature to vessels and excretories; extirpate glands; we make animals fast, or feed them exclusively with gluten or sugar; we place them under the air-pump, or in an atmosphere of hydrogen; withdraw their blood; inject foreign substances into their veins, either water or poison. Creatures treated in such a manner are well called sick! It is true that the physician is more directed to clinical observations, and the physiologist more to experiments; but the practicable accomplishments of both can only be attained by putting together and comparing their interchanged experiences: both are under equal obligation to make use of the aggregate material. If, notwithstanding this, pathology can exist as a discipline separate from physiology, then the cause must lie in the diversity of the way which both take, and in their accidental imperfection. Physiology begins with the organs, in order to discover the different manners in which their vitality shows itself under different conditions; pathology with the vital indications, in order to discover at the other end the vital organ, and the conditions of its abnormal vitality. There are symptoms, and groups of symptoms, to which physiology, on its way, has not yet ascended, and to whose sources pathology has not yet descended. Until this shall be done, — until both paths alike shall meet each other,—there remains between them a chasm, which it is more

for the interest of pathology, than of physiology, to mark out and to fill up.

The Materia Medica of the rational physician is also a physiological doctrine, because it is occupied with obtaining an insight into the *modus operandi* of the remedies upon organic matter. But this is particularly difficult for this reason, that the therapeutical experiments, from which the conclusions have been drawn, are too complex. To the simplification of these our efforts must be directed. To this end we must investigate what changes the normal organization undergoes by remedies approved in diseases; compound drugs must be analyzed chemically, their ingredients especially examined and compared, by which means not only the active principle of each, but also the basis of their affinities in a therapeutical point of view will be made apparent: lastly, we must examine the action of chemical agents upon single humors, textures, and more intimate ingredients of the organism.

When at some future day it shall be possible, from the nature of diseases and of remedies not only to point out indications, but also *à priori* to determine the mode of treatment which corresponds to the same; then shall we obtain a rational therapeia, which the now so-called general therapeia comprehends, in the same manner as the general comprehends the rational pathology. But here also before all, and before we can reason thereon, the field must be more extensively cultivated, and the weeds exterminated which the hermeneutic mania of the so-called empiricism has sown among the sparse grain. With so many general and causal indications as we are accustomed to, we run the risk of building upon, and of fortifying error. According to our experience the symptoms occasioned by taking cold are removed by remedies which produce perspiration. Who does not believe, if he progresses upon the safe road of empiricism, that he acts upon a principle of the healing art, in a case of sudden cold, by exciting the secretions of the skin! This is esteemed the *indicatio causalis*, because the results of the "catching cold" were derived from the suppression of the activity of the skin. But the "cold," as we will show, is not injurious by retaining the

perspiration, still less by repelling it, and on this account diaphoretics are not salutary because they promote perspiration: the diaphoresis is only a sign of the excitation of the nerves of the skin, and in most cases certainly of no other importance than the serum which accumulates under the epidermis after the application of a blister. So it would happen in many cases. We give an emetic in order to evacuate the bile, or to prevent impurities being absorbed in the blood, but it operates by stimulating the activity of the involuntary muscles; we purge the sick person in order to disencumber him of the accumulated mucus, and change the retained fibrine of the blood; we bleed in order to lessen the momentum of the circulation, and this conduces directly to the evacuation of the vessels, and promotion of resorption.

Rational therapeia has its special part, and this must be the foundation of its general part. The special rests upon facts partly of rational pathology, partly of empirical therapeia. Where these facts have once advanced, on the before-mentioned way, as far as to the simple or complicated cause of a disease, there follows necessarily, rules for prevention, and cure; we have to antagonise those causes, or to neutralise them, or to restore the altered organic matter to its normal form and composition. Thus certainly we proceed according to reason in many cases, especially in surgery; we remove tumors which injure neighboring parts, we make an outlet for accumulated pus, we destroy the organic substance in which the vital powers become incapable of effecting the normal regeneration, &c. We prescribe rest, where a part is changed through excessive exertion; exercise, where it is altered through inactivity. We could *à priori* occasion the removal of the lithic-acid diathesis by restricting all food furnishing azote, the prevention of the sugar formation in diabetes by withholding all vegetable food, &c.

But in many cases our knowledge reaches not so far as to establish the rational indications; in others, where similar indications cannot be arranged, we should not know the remedy corresponding to them. Under these circumstances we take the empirically established efficacy of certain medicaments in certain diseases as a fact, and try it in the same, with our explanations.

Here is, without doubt, the most difficult, and at the present time the weakest side of our science. The cure is the product of two factors, disease and medicine: if the one factor is in a measure known, then can the other be found out by way of approach; the *modus operandi* of the remedy is argued from the nature of organic changes, and *vice versa*, *ex juvantibus et nocentibus* is argued the nature of the disease. But for the most part the problem is more difficult from the fact that we are to find both factors. Then several solutions are possible; but this is an unfortunate position, which the multitude of expounders knew at all times how to turn to their advantage. China cures fevers,—it is a nerve remedy when the fever originates from the nervous system; it purifies the blood, when the cause of the fever would be sought in the blood; it is efficacious by means of its hydrogen, when in fevers the oxygen predominates, and by means of its oxygen, when the predominance of hydrogen is the last basis of the fever, &c., &c. To this must be added, that the cure of the disease is possible not only by different remedies, but by remedies efficacious in different ways, inasmuch as at one time one, and at another time another cause is removed: and hence it follows that even analogous therapeutical results do not authorize us to conclude upon the internal analogy of the therapeutical method. If, for example, irritation of sensitive nerves, fibrine in the blood, and paralysis of the vessels must meet together, in order to produce the symptoms of inflammation, then can remedies which quiet the nerves, which check the formation of fibrine, and which stimulate the vessels to contraction, although entirely different among themselves, be associated in the same character for their antiphlogistic effect, or in other words, it will be difficult and even impossible to determine the peculiar efficacy of any one of these remedies from its effect.

If we consider all these difficulties, we shall then be inclined to commit the preparation of a system of rational therapeia to a more distant future. Meanwhile the general therapeia contains firstly a collection of general rules concerning the management and the knowledge of the physician; afterwards a general division of pharmacology, wherein according to known categories, and

under the name of recognised methods, the practicable interferences by dietetic, mechanical, and pharmaceutical remedies will be grouped together.

III. SYSTEM OF RATIONAL PATHOLOGY.

Rational pathology and physiology are identical; the system of both is therefore the same; it is the system of all empirical, and especially of the natural sciences. I have already had occasion to mention how the inclination to synthetic treatment operates against the progress of science. Our time, which has still so plainly in view the errors springing out of a natural philosophical system, cannot fail of perceiving the duty to oppose such inclination. The renunciation of error is a virtue in the intellectual as in the moral world. In both realms there is a conflict between the mind, and the senses; in the one the dignity of the intellect is to be maintained against the pretension of sense; in the other the real worth of sense against the unbridled flight of intellect; here the crown is obtained by the preservation of the body, there by the endurance of the soul. As the final reward of fidelity, to the resigning body is promised a future of undisturbed happiness, to the departing spirit, a view of the entire naked truth, with this difference, that there the individual reaps, here the entire race. Not the easy victory of innocence which knows not pleasure, nor the easier victory of impotence which is incapable of enjoyment, will be acknowledged as virtue; so rests also real learning, not in ignorance or contempt of philosophy, but in the conscious temporary renunciation of the knowledge of the first causes of things, while the time of probation is not yet passed.

As rational pathology does not originate from any one supreme principle, but from individual ones, so it makes no pretension to rule the whole dominion of our knowledge; it confesses on the contrary, that medicine according to the existing fundamental principles of the auxiliary sciences, and of empirical medicine itself, should have its accessible and unaccessible sides. Clini-

cal observations, or in their stead the morbid representations of special pathology, form the firm foundations, as it were, the outline whose individual parts, as they become accessible to it, inconstant theory amplifies. The way of progress from the observation of individual and proximate opinions, to comprehensive and always more comprehensive conclusions, is the alternate passage between hypothesis and experience, between interrogation and answer, to which the physical sciences owe their flourishing condition. Entirely pure experiences, and those free from prejudice, are not only in the domain of medicine, but generally impossible; to express a sensible perception, is already to separate the essential as the subject, from the accidental as the predicate, at least is to concede, by way of presumption, that that subject could be considered without that predicate, or with another. If this presumption is once allowed, then the question immediately arises, whether that which is separated in the thought should be likewise separated in reality; in other words, whether the predicate should be necessary, and inseparable from the subject, or not. Strictly speaking, this is only a formal syntactical difference, if the question is expressed as an hypothesis, as an affirmative proposition, which should be preliminarily valid, until it is confirmed, or refuted by more extended investigation. In this respect, the form of an hypothesis has the advantage, that we dispose of the preconceived opinion as with a well-grounded principle derived from experience; we argue farther, and when we cannot directly demonstrate it, we fortify the same by the observation that the consequences, resulting from it from different sources, prove it correct.

I have already discussed the manner in which an insight into the causal connexions of symptoms is in general, attained. What particularly concerns our theme is, that we are apt to be led by the coincidence of certain morbid symptoms with determined material changes, to the adoption of a causal relation between the two; by experimenting, we as far as is possible settle arbitrarily the causes, and assure ourselves of the correctness of our conclusions, by observing the results. Therefore, we must next investigate the so-called localization of the symptoms,

that is, the ascertaining of the organ from which they arise, and more remotely also, the knowledge of the quality of pathological changes, by a comparison of the altered form and substance with the normal. The deeper we penetrate into the more delicate structure and composition of the tissues, even so, more multifarious, important and essential differences are disclosed by the investigation. Pathology, therefore, is indebted, for the most important facts, to the application of the microscope, and of organic chemistry. The object of the latter is to restore the phenomena of diseases to the territory of material events, as far as is possible by physical and chemical processes, and thus to bring these, with post mortem appearances, under one general point of view. Where explanations by physical and chemical forces cease, recourse has been had to an hypothesis of the vital power peculiar to the organism. This is not to be censured, because as far as the formula is concerned, the hypothesis of the vital force is just as good, or just as imbecile as the hypothesis of gravitation, and of elective affinity. That we desist from it, only deserves censure; because we withdraw, thereby, not only a material for further investigation, but we despoil the organism of that power which governs it, on a correct estimate of which, the success of the physician and the life of the patient depend.

But if pathology attempts to enter into the rank of the physical natural sciences, she must appropriate to herself their logical acuteness, especially on one point, which we therefore particularly notice, because it marks out a significant difference between empirical and rational medicine. The science of the empiric treats of diseases, or a complex of symptoms; a single symptom is of no value to him: the rational physician, on the contrary, analyzes the morbid structure into its constituent elements, and searches after the cause of each symptom, in order to explain them individually. To the empiric, a symptom can signify very many different things, because it happens in the most heterogeneous combination: to the rational pathologist, a symptom always signifies but one thing: he considers only the material changes as the cause with which the symptom stands in necessary and inseparable connexion, so that the one cannot be

considered without the other. "The very fact, that by a process of reasoning upon pathological and even of physiological objects we jump over to the remotest causes, neglecting a series of intermediate ones, has given prevalence to that loose logic, which has made medicine, in contrast with the so-called exact natural sciences, the subject of ridicule; only in medicine do we find causes which have a hundred different effects, or at discretion, no effects at all; only in medicine is it allowable to derive one and the same effect from the most heterogeneous sources. Cast but one glance at the chapter of etiology in the manuals and monographs; in almost every disease, after stating a special cause, or after the admission that no such cause is known, do we not see mentioned as predisposing causes the host of morbific influences, poor habitations and clothing, brandy and love, hunger and sorrow?" This is just about as scientific as if a natural philosopher should teach that the fall of a body had its origin from withdrawing a board or a beam, from the breaking of a rope, or a wire, from the existence of a hole, &c. Empirically it will have been discovered that the symptoms of remittent fever keep pace with the diminution of the fibrine of the blood, and that a continual connexion is maintained between those interruptions of function, and this abnormality of the blood. We admit it for a moment, notwithstanding we consider it as not proved, yea, even not as probable, that the alteration of the blood could be really the first cause of the affection; then, it is true, we could regard the defective composition of the blood, in an empirical sense, as the cause of the fever, that is, of the complex of symptoms, but not, in the sense of rational pathology, as the cause of the single symptoms of fever. By the adoption of such an argument we should commit nearly the same fault, as if a natural philosopher argued that sight was produced by compression of the air, because in densely compressed air, a combustible body becomes heated and blazes, and when it blazes emits light. We would overlook the fact that heat, acceleration of the pulse, thirst, delirium, &c., each might exist without the specified condition of the blood, and the diminution of the fibrine without those symptoms. Thus by excluding all points of connexion, we deprive ourselves of the means of learning by experience what

change always and necessarily was connected with the above-named vital indications, what result always and necessarily was connected with the before-mentioned decomposition; we neglect to investigate the conditions, which in the one, or the other case destroy, or change the results of an effective cause.

Yet once more, and for the last time, I must return to the comparison of empirical and rational medicine, in order to show how, by the actual replenishment of the latter, the chasm between both can be filled up and both be placed in a position, henceforth to travel amicably in company with each other.

As long as pathology constructed her theoretical fabrics out of natural philosophical material, practical medicine was authorized in its opposition. Its conflict was, as it were, a conflict for experience as opposed to synthesis. At the present time, the sources and the direction of both are the very same; the path of theoretical medicine is that of empiricism, but, if I may use the expression, in a broken line. The empiric proceeds directly from the complex of symptoms to the cure; the causal connexion between the two is inferred from the coincidence of the treatment and recovery: the theorist infers, in the same manner, from the symptoms, the organic cause of the malady, and from this the changes which ought to be induced. Both experiment; both acquire certainty through the number of observations and experiments. If the path of the empiric is the shorter, so is, on the other hand, every single step of the theorist more certain, because the experiment of the empiric is more complicated, must on that account be so much oftener repeated, and notwithstanding this the relations cannot be reproduced arbitrarily, according to necessity; the experiment of the theorist is simple, it gives therefore a decided result, and may easily be multiplied. The hypothesis of the empiric, that, namely, the recovery should be owing to a certain treatment, is unprofitable, and always only to be proved correct in one way; the hypothesis of the theorist, which concerns the connexion of cause and effect between the influences, organic disturbances, and phenomena, may be applied and proved in many ways. From the evils to which empirical medicine is exposed, by the difficulty of control and the abuse of authority, the rational system has less to suffer, and in order

to contribute to its success, it requires, at the present time especially, no external promoting circumstances, and neither much more numerous nor more rare cases.

The true enrichment of our science, results equally beneficially from both systems. What symptoms from a complex belong together, which arise and disappear with each other or alternate, will be always first ascertained empirically, before an examination of their internal connexion can be attempted. But by placing thereupon hypotheses, and proving their durability in given cases, we cannot fail to behold more accurately the phenomena themselves; furnished with a preconceived opinion, which we must not allow to bias our minds, we should more correctly see more and many things. Unfortunately it proves, only too often, the old saying, that to him who looks through the colored glass of a theory, the objects appear colored, but nevertheless in ordinary circumstances they entirely escape the unaided eye of the so-called moderate observers. Even that theory is still the beginning of an experience.

Why, in the descriptive natural sciences, should it be indispensable to each one who arranges known bodies into a system, from a new point of view, to study nature with his own senses, while others who proceed from other points of view, have considered heterogeneous bodies as identical, and have overlooked characteristics which have now become essential? And if this is done with objects where it depends only on determining permanent characteristics with regard to their relations to each other, how much more will the occasion to error be augmented, where changes shall be represented in their reference to each other, and external phenomena in their dependence upon internal changes.

When finally empirical medicine, dissatisfied with the therapeutical results hitherto obtained, feels obliged to attempt new methods of treatment, then will it put itself under the guidance of its twin-sister, rather than longer endure the disgrace of that lamentable inefficiency, which seizes upon anything fortuitous, in order to experiment hap-hazard upon some victims, too few for profitable results, too many for a tender conscience.

IV. CONTENTS AND DIVISIONS OF RATIONAL PATHOLOGY.

Rational pathology is divided into a general and a special part.

The first part is discussed in four sections:

1. The inquiry into the idea and nature of disease.

2. The doctrine of the causes of disease in general, or general etiology.

3. The local relations of disease; the conditions of its propagation in the organism; the manner of its transition from one organ to another.

4. The relations of disease in regard to time, or the general history of disease, its course, duration, and termination.

For the special part, which is occupied with the investigation of the particular phenomena of disease, the first thing is to ascertain certain points of view, according to which matter may be arranged and grouped. It is certain, that the multifariousness of the pathological vital indications will be limited only by the great number of external causes and of tissues or organs, and that the specific form of disease always depends upon the concurrence of the concrete cause and the concrete organ. If there was but one morbific influence, still we could see as much difference in the specific forms of disease, as of organs: if there was only one organ, still we should have as many species of disease, as different efficient causes. We can, first, proceed from causes, to group the results of determined external potencies, and after that, endeavor to ascertain their influence upon the organic substance in general, then upon single organs and structures; this is the province of special etiology. We can, secondly, proceed from the organs, to concentrate in one totality the sum of the symptoms which appear in the compass of a morbid affection of each organ, in order, after having learned its whole possible mode of reaction, to pass on to the question, under what circumstances the one or the other would actually appear. Symptomatology furnishes the representation of the group of symptoms of each organ: this may be called special, in opposition to a

doctrine contained in the third section of the general part, concerning the value and relations of symptoms in general: we must also distinguish it from Semeiology, which treats of symptoms as the signs of an empirical-pathological species of disease, and therefore only in relation to their position in an empirically determined complex.

Up to the present time, we have not seen the contents of rational pathology exhausted by special etiology, and symptomatology: still near at hand we meet with a special *pathogeny, nosology, a doctrine of the pathological processes.* How was it possible, that a *third* could have been made valuable to the two before-mentioned principles of abstraction, out of which no other is imaginable, according to logic? I will next show the way, by which it has sneaked in, and then demonstrate in what sense it is entitled to a continued existence.

From the beginning, the symptoms of disease had been considered as functions of a new unity, the personified disease, instead of as vital-indications of the suffering organism. This was the necessary consequence of the system and method, according to which we were accustomed and compelled to consider nature. If we even recognise ourselves and the creations around us, as the simple, individual cause of a series of actions and developments, then we substitute, arguing retrospectively, a simple individuality, for each complex of phenomena; a storm was considered as the simple cause of the thunder, lightning, and rain, until philosophy had taught, that the totality of these phenomena originated from the play of the forces of known atmospheric elements; and just so, diseases and pathological processes were laid down as the simple cause of the association of pain, convulsion, tumefaction, discharges, &c., before it was demonstrated that these and other accidental cases are nothing but manifestations of the forces of our particular organs.

Unfortunately, quite early, by means of an art of localization, a partial acknowledgment of the truth had ensued, which only served to protect error from a radical attack. By a comparison of the different complexes of symptoms promoted to species of disease, the influence of single, more important organs upon the

whole structure could not remain concealed: there were found connected with certain constant groups of symptoms, others of a constantly repeated course which was varying, distinctly referring to certain organs. *This* was appropriated to the organ attacked, *that* was allowed to the pathological process, and men consoled themselves with the representation that the same morbid process fixes its seat in different organs, contains a propensity to the one or the other, and can be varied by the dignity of the organ. The symptoms, which in the concrete case are the most prominent, belong sometimes to the so-called pathological process, sometimes to the sympathy of the specific organ; thus, for instance, an inflammatory disease can be inferred from the temperature, pulse, composition of the blood and urine, without stopping to decide upon the seat of the same, or disease of the liver can be diagnosed from the color of the skin, the taste, appetite, and the stool, without determining the nature of the process. By considering diseases which appear in different organs, abstracted from the functional disturbances which they occasion in particular cases by a particular location, we create that third part of general pathology, whose different signs I have given above.

But if diseases of physiologically different organs can resemble each other so far, that besides the essential similarity of the symptoms and of the course, the disturbances of the peculiar physiological functions appear only as an accident: then it must be only because structures of the same energies are repeated in different organs. As far as the blood and blood-vessels are extended, congestion, extravasation, inflammation, are possible; in so far as the function of the blood and of the vessels is the same in all organs, must affections of these structures have the same results in all organs; but in so far as one organ effects motions, another secretions, a third the reception of oxygen, must the same changes of the circulation produce different results.

With regard to symptoms, what has hitherto been conceded to the pathological process, belongs therefore to the homogeneous structures which are repeated in heterogeneous organs; the doc-

trine of the pathological processes becomes the symptomatology of homogeneous structures, and thereby only is the belief in the personality of disease entirely destroyed.

If our science shall ever be perfected, then will its special part embrace two divisions,—etiology and symptomatology; and the latter, the groups of symptoms, will be in two subdivisions, the first representing the tissues, and the second, the organs corresponding to the anatomical arrangement of the constituent parts of the human body. But as long as the specific causes and the seat of a very great, perhaps the greatest multitude of diseases, are concealed, or at least questionable, we cannot omit a chapter upon the pathological processes, that is, a chapter where the diseases without regard to their external and internal causes are arranged according to the symptoms. I shall treat of pathogeny, as far as possible, according to established fundamental principles, without concealing the defects of our knowledge.

But a scrupulousness in the arrangement of the materials, will never be overcome—certain parts of the body will never be considered exclusively either as organs or as tissues, and their pathological vital-indications will always admit of representation as well in their pathogeny as in their symptomatology. Thus, I think, for instance, it may remain always a controversy whether the neuroses, like inflammations, tumors, and others, are to be admitted under the pathological processes, or are to be treated as a group of symptoms of the corresponding organs, the brain, the nerves, &c. The solution of this question appears to me as difficult as it is indifferent, and I would not have touched upon it, if I had not to add the remark that some one of the two must be adopted, no matter which one. It will therefore be necessary to speak of the importance of this rule of conduct, and of the erroneous opinions which have prevailed from neglect of the same, particularly in reference to nervous and mental diseases.

In the nosological systems, as has already been remarked, are used as generic characteristics, sometimes the complex of symptoms which belongs to a determined pathological process, sometimes the complex of symptoms by means of which a determined

organ or system of organs discloses its own pathologically changed condition. Genera of the first kind are, for instance, inflammations, tumors, &c.; genera of the latter are, lung, liver, and nervous diseases. If we make use of the organs as the basis of arrangement, and group the different diseases of one organ in one division, then we tacitly allow that, from the symptoms whereby a disease of this division is principally recognised, it is easier to conclude upon the affected organ than upon the process of the affection. But then we should be consistent. If, in one or the other malady of such a group, we succeed in ascertaining the species of affection (I select, by way of example, the nervous diseases), as is the case in inflammation of the brain and of the nerves, in neuroma, and others, then we must not, on that account, separate it from the rest, nor place it in the corresponding genus of pathological processes. It is this arbitrary method of procedure which has rendered difficult and inefficacious the sources from which empirical and rational medicine are supplied. The treatment of mental diseases has suffered most thereby. In any case, delirium is a symptom, through which we learn that an organ, the organ of thought, is attacked; but not how—by what pathological process. Now there are cases in which this symptom is the only one, or at least the most prominent: in other cases, it is accompanied and thrown in the back ground by symptoms which indicate a determined pathological process of congestion, inflammation, softening, &c. If that symptom, delirium, can in general be adopted as a characteristic of a genus, then all the above-named cases belong to it: then is every disease, in which there is delirium, whether it be from wine, inflammation, or tumors in the brain, a mental disease. If this cannot be adopted, there remains nothing else but to annihilate the family of mental diseases, to arrange in their proper places the individual diseases of the organ of thought of which the pathological process is known, and to suspend the arrangement of the rest until a process forming the basis for the changes of function of the mind shall be discovered. But we find ourselves in a peculiar circle, when, from a group of diseases, we exclude and transpose those by which the connexion between material changes and

symptoms can be proved, and leave behind those which are characterized only by the fact that no such authentic connexion exists. And we deprive ourselves of the most important aids in studying those diseases, if we directly remove those which are best known, which can be investigated in the most complete manner, and from which we are to expect disclosures with regard to the rest. Very differently acts the naturalist, who makes use of all that may be collected under one determined point of view, in order to vindicate his own conclusions, and what he has ascertained with certainty of any species of a group, he bestows upon the others. Following his principles, we will call nervous diseases all those, whatever kind they may be, in which a disturbance in the functions of the central organs or single nerves indicates an affection of the same, and especially those mental diseases, in which the organ of thought shows itself attacked, primarily or secondarily, through congenital defects of structure, or through inflammation, or tumor, or congestion, or lastly, of any other species for the present capable of being known only by means of the disordered functions.

We can, at all events, call convulsions, pain, delirium, in the one case essential, in the other symptomatic; as far as concerns us, they are always symptomatic, always symptoms of affection of a special nerve, to discover whose manner of reaction we must use not only all kinds of morbid indications, but also the slightest disturbances occurring within the latitude of health.

With regard to the arrangement of the special part of this work, it has appeared to me most agreeable to our purpose to commence with the Pathogeny, then the Symptomatology, and to conclude with Etiology.

V. HISTORICAL VIEW OF MEDICAL SYSTEMS.

In the first paragraph of this introduction, the origin of theory and its relation to experience, was in general discussed; in the following, the origin and contents of the most important systems, which the concrete progress of development of human science has actually called into existence, shall be sketched in concise

order. No theoretical opinion has passed by trackless, and entirely destitute of influence upon the formation of our theoretical conceptions; on the contrary, there appears to be a strong tendency in the ideas of modern times to relapse into the more immature forms of theory, in spite of all attempts to adopt refined discoveries. By surveying them all, we shall the more surely avoid new errors, and much more correctly consider the value of each, perhaps, still prominent theorem. Now, as it is impossible, on account of our technical language, entirely to dispense with traditions, we shall, by this arrangement, avoid the split-up definitions of isolated dogmas, and, as far as is necessary, we shall criticise as we proceed, in order to be able to refer to it hereafter.

The ancient physicians obviated or combated disagreeable sensations in the same manner as now the physicians of barbarous nations, or uncultivated people among civilized nations, without general pathology, and without a nosological system. They felt the necessity to eat, and obeyed it; that is, they treated the symptom of hunger with the proper empirical remedies, before they thought to explain or define the nature of their food, to analyze, or to classify it.

Soon, however, the inclination to inquire after fundamental principles obtained. Science took possession of medical doctrines and experiences, as of the rest, and sought to derive, from one first principle, the whole dominion of our thought and knowledge, and collect it in a philosophical system. But philosophical systems are transitory and defective, because they not only necessarily presuppose the prevailing empirical knowledge, but also the excluded, at the time concealed, facts. As those became dubious, and as new discoveries were added, the explanations of a prominent philosophical principle became insufficient, and the principle was overthrown. The zeal of investigation developed itself until another great discovery became the basis of a new theory. In the history of empirical sciences, therefore, periods are formed, the development of each of which embraces a system, from its origin to its termination, and the return to new observations. Each period is divided into two parts, although not rigidly sepa-

rated, which bear the same relation to each other as exacerbation and remission, or as paroxysm and apyrexia. During the paroxysm, all isolated sciences are pervaded by one leading idea, by means of which they are united; in the apyrexia they become separated. The paroxysm is exclusive, fanatic; in the apyrexia appear eclectic experiments, in order to collect a scanty shelter from the ruins of demolished systems. The paroxysm is consistent; the apyrexia furnishes the so-called ingenious isolated hypotheses, the genuine *spirituosa*, with which the longing after a nutrient science is stifled. Medicine always attached itself closely to physiology, in the times when theory prevailed; in fact, medicine applied it to its own use primarily, but disposed of it as soon as the physiological dogmas, with their recent experiences, became involved in inextricable contradictions. Herein it appeared like one, whose companion had innocently forfeited its esteem and confidence, and, mortified at the offence, had resolved henceforth to wander alone in the troublesome path of empiricism. If medicine kept not strictly its word, if it often alternated traditional dogmas with empirical theorems, and often sought its therapeutics in the crudest symptomatism, instead of more suitable observations, then still are we indebted to such successive periods of artistical independence, for the important enrichment of diagnosis, the improvements in the methods of exploration, and for the successful attempts to augment the materia medica.

According to the above specified fundamental principles, we may adopt seven periods in the history of our science. In the first period, from 500 to 100 B. C., the Pythagorean philosophy of nature predominated, and was the first empirical school founded. The second reaches from 100 B. C. to the beginning of the sixteenth century after Christ: it begins under the influence of the corpuscular philosophy, and ends with the regeneration of the empirical sciences. In the third period, from the beginning of the sixteenth to the seventeenth century, occurred the development of the doctrines of Philipus Aureolus Bombastus Theophrastus Paracelsus. The fourth, which occupies the first half of the seventeenth century, embraces that one-sided system, originating from the advancement of chemistry and physics. In the

fifth, which extends as far as the commencement of the eighteenth century, we see the reaction against the materialism of the foregoing period, in the systems of Hoffmann and Stahl, until their overthrow by the nervous physiology. The nervous physiology, in its turn, yielded to the access of the theories of nervous pathology, which, in the sixth period, in the second half of the eighteenth century, predominated; but owing to their exaggerations soon perished. The philosophy of nature, by Schelling, at the beginning of the present century, furnished a seventh period, in the second empirical half of which we are now living, and long may we enjoy it!

FIRST PERIOD.

By means of Pythagoras (+ 504) and his school, medicine first passed from the hands of the priests into those of the philosophers and naturalists, and became the object of scientific treatment.

The oldest philosophy of Orpheus and of Pythagoras, embraced four elements (the number four was considered sacred), from which all nature, and also the human body, originated. Physiology restricted itself to accomplishing this arbitrarily and according to certain analogies, to referring to individual elements the dominion of individual organs, and farther, to deriving from the same principles the empirical vital-activities of certain organs. The motions of the individual life were conferred upon nature, and the uncommon and magnificent events of the external world were considered as a contest of the elements; so also the storms and tumults of the organism, as a conflict of its constituent elements, as the consequences of the disturbed equilibrium. Alkmäaon defined the equilibrium of the forces of the elements as the essence of health; the predominance of one of them, as the essence of disease.

The ancient philosophers, and among them Empedocles, considered the elements of godlike nature as inspired, and that in their effective causes of union and disunion, were friendship and enmity. Their pathology was, therefore, not the humoral patho-

logy, because their elements were not humors. But by a partial improvement of that foundation arose the system which considered a defect of the fluids, *humores*, as the first cause of every disease.

Hippocrates (+ 370?) or his school, first substituted for the elements, fire, air, water, and earth, or the corresponding elementary qualities, heat, cold, moisture, and dryness, the four humors, which in later times were called cardinal humors: *blood*, *mucus*, *black* and *yellow bile*. The living body was formed, not by a concourse of these, but by their mixture. A deficiency, an excess, or a disproportion of these, produce diseases: the cure is effected by re-establishing the customary relations.

With this view of the causes of disease, the existence of a morbid matter was allowed, a *materia peccans*, a *crudum et intemperatum*, which the diseased body had to manufacture and to secrete; an opinion, which the discharges with which acute diseases are accustomed to terminate, served to support. Hippocrates distinguished the stages of *crudity*, *paroxysm*, and *crisis*. The paroxysm, whereby the former acrid and thin humors become more mild and more consistent, happened by means of the inherent heat, and is directed by a godlike, autocratic, and foreseeing wisdom of nature. According to the time which nature spent upon this process, were determined the critical days, which were prognostic. Perspiration, urine, and nasal hemorrhages are described as the most important critical excretions.

Of the followers of Hippocrates, the Dogmatists, Praxagoras is to be considered as the one who caused the predominance of the system of humoral pathology. According to him, the blood is prepared from the food, if its ingredients are mixed in proper proportion; but if any one ingredient in particular predominates, there are other juices produced from heated parts: juices like the gall, and hence inflammatory and bilious diseases; from cold ingredients, phlegmatic juices and chronic diseases. Praxagoras adopted a multitude of different humors in the body,—sweet, sour, salt, bitter, bilious, corrosive, &c.

An advance of the humoral pathology towards the pathology of irritation manifested itself at the end of this period, occasioned

by the commencement of anatomical knowledge in the doctrine of *Erasistratus* (born 297), a cotemporary of Herophilus. He explained inflammation and fever from the aberration (παρέμπτωσις) of the humors; from the intrusion of an unnatural blood into the arteries, or into the small vessels.

Theory and Empiricism stood opposed to each other not so violently in this first period as later, because theory was not yet so perfected in all its parts as to have direct influence upon the practice. Hippocrates himself rarely descended from his general opinions to the proximate causes of diseases, and confessed that experience was wanting to physicians in order to decide whether in diseases the debility was the consequence of the evacuation of the vessels, or of some other irritation, or whether it was the result of the pain and violence of the disease. If he appears in the explanation of facts entirely like a child of his own mythological age, so is he, in reference to the delicate, sensible perception and representation of observations, a model for all ages. The contradictions of theory, and at the same time the augmented material of experience of their insufficiency, first appeared in the pretensions of the schools to individualize speculatively. Aristotle taught the method of experience: the stoical philosophy referred to experience as the source of all knowledge: in that, Philinus of Coos (about 279), the founder of a medical sect called the *empirical*, was educated. Accident, experiment, and conclusion according to analogy, were called the sources of experience. The last was used in order to guide in the treatment of new diseases.

The development of the empirical method had furnished new remedies through the successful treatment of the Ptolemaians. Then was the attention of medical men aroused to the proving of numerous remedies and formulæ. We learn through Galen that at that time, they particularly considered specialities, and there were actually physicians for every region of the body, even in the literal sense of the word, physicians for the anus.

SECOND PERIOD.

The corpuscular philosophy of Epicurus was the foundation from which arose the first solid pathological system. Epicurus explained the existence of the world from the accidental cohesion of atoms (Homoomerien), whose different shape and delicacy was the cause of the different forces of animate and inanimate bodies. Asclepiades of Bithynia in Rome († 56 B. C.) was educated in this philosophy, and adhered still to the humoral theories of the former period, particularly to the pathology of irritation of Erasistratus: he defined disease as the consequence of an abnormal mixture of the atoms, but at the same time of an abnormal motion, and a disproportion of the same to their vacuum; on that account constipation (ἔνστασις) appeared to him a frequent cause of disease, and he considered the humors only as the more remote occasions, not as proximate causes of disease. All consideration of the humors was entirely dispensed with in the school of the Methodists, at whose head stood Themison (63 B. C.) The investigation of the remoter causes appeared to him, too uncertain, and so he sought to refer each morbid condition only to the proximate cause, the changes of the solid parts. Three modifications of the solid substance were presented to him, from which all pathological phenomena must be derived, stricture, laxity, and the mixed condition (*strictum*, *laxum*, *mixtum*). These three conditions are the communities (χοινότητες) of the Methodists; from them were derived indications for treatment; and the remedies divide into three species, according to the community which was determined to include them. To these indications of Themison a fourth was added by Thessalus (50 B. C.), all of whose names have been retained. If, namely, the symptoms of relaxation and contraction failed, then a change, a metasyncrasy, that is, an entire alteration of the condition of the pores with regard to their atoms, must be attempted by diet, emetics, cutaneous irritants, and others.

As a reaction against the atomical materialism of the Methodists, there existed beside them, without any particular influence upon their time and history, a Pneumatic school, whose leader was Athenáus (A. D. 50): it derived its name from the recog-

nition of a *Pneuma*, in the sense of the Platonic philosophy, an immaterial, active principle, which was the basis of existence, and whose injury or disparagement was the foundation of diseases.

On the other hand, the system which first styled itself Eclectic corresponded entirely with the encyclopedian spirit of Romish civilization, and accomplished all which a nation could expect and comprehend, who only knew how to root up all the bloom of culture from foreign soil and to transplant it in its own hot-houses. The founder of the Eclectic system was Agathinus (81 A. D.) A pupil of his, if not in name, still in reality, and certainly the most prominent was Galen (+ 201 A. D.) A history of special medical disciplines might extol the erudition of Galen, in his time astonishing, for the number of his discoveries; a history of empirical medicine would rather extol his faithful observations, his and other eclectic's merits in the discrimination of diseases, and their multiplication of the internal and chirurgical remedies: but in the history of medical theories Galen is only the representative of that impotent, neutral *éclaircissement* whose origin and value I have spoken of above; and we can attribute the unparalleled duration of his system, not to its intrinsic merit, but only to the accidental circumstance that it was the last before the decline of the Roman empire, and before the barbarity of the middle ages.

The basis of the pathology of Galen is the humoral pathology of Hippocrates; where it is insufficient, the consideration of the solid parts externally is added: finally, for isolated cases the immaterial principles of Plato and the pneumatic school were called to assist. Health consisted, according to Galen, in the perfectly equal mixture of all the elements of the body, and in the correct relation of the solid parts to the fluid. Disease is an unnatural condition either of homogeneous parts or organs. Diseases of homogeneous parts arise either from mechanical disturbances, contraction and relaxation, or from the disproportion of elements, according as either one, or two at the same time predominate. But the elements or cardinal humors are identical with those of Hippocrates; from the alterations of these eight

different dyscrasias are produced, from the predominance of the one, or the other, the four temperaments, which still at the present day by their names betray their humoral pathological origin. The diseases of the organs are referred to their number, size, or situation.

In the explanation of individual diseases, Galen stands beyond Hippocrates only in that he proceeded with greater boldness, but also with more absolute arbitrariness, in the application of general fundamental principles. He knew of the vitiation and stagnation of the fluids in fevers, and derived the different kinds of fever, with the exception of the ephemera, which consist in the heating of the *pneuma*, from the corruption of the different humors, the quotidian of phlegm, the tertian of yellow, and the quartan of black bile (gall). Inflammation was to him an *error loci* of the blood, but specifically different according as the blood alone, or phlegm, or yellow or black bile, leaked into the fine vessels; he called them on that account, phlegmonous, phlegmatic, erysipelatous or schirrous.

This is not the place to specify the causes which, in the last years of the Western Empire, and after its fall, occasioned the entire decline of science. Medicine formed no exception. Among the later Greeks and Arabians there were found only blind plagiarists and imitators of Galen, few who, like Alexander of Tralles (543), still extended wider the fundamental principles of Galen, or connected them to other systems. Besides, in medical practice the most absurd superstitions prevailed. The Alexandrian Jews cured by magic, and the monks by relics. Afterwards the scholastic method usurped medicine, as other sciences. Its peculiarity lay more in the choice of the point of success in the object of its investigation, than in the treatment of the object. When they devoted themselves, in pious thought or in deference to external might and power, to the proving of the decisions of certain authorities, then those decisions became elevated to the rank of laws, and then, at the same time, commenced the empirically established laws of nature, teleological and genetic. The same thing happened with regard to biblical traditions and with regard to the doctrines of Galen; and all that was farther

construed thereupon, however ingenious, became immediately worthless, as soon as the faith in that fundamental basis began to totter to its fall.

This happened in the sixteenth century, in the age of the revival of criticism in every dominion of thought and science. The first step consisted in turning their attention to the literary sources of science, and in restoring in their purity the writings of the Greeks; the second step led them beyond the sources to the independent observation of nature. Anatomy, newly created by Vesalius (+ 1564), as soon as the dread of dissection of dead bodies had subsided, acquired discovery upon discovery; pathological anatomy, in the beginning a mere collection of abnormalities, soon gave disclosures with regard to the seat of diseases, and revealed the errors of the system of Galen. The great anatomist Eustachius (+ 1573) had already recognised the full importance of pathological post-mortem examinations.

Practical medicine had received some few improvements even under the oppressive sway of the Galenic laws; now appeared new diseases, and after the discovery of America new drugs, which demanded the advancement of empiricism. But already the re-established Hippocratic mythos had assumed a form corresponding to the time, and thus again, longer than would seem at the first glance, swayed the minds of men.

THIRD PERIOD.

The enemies of Paracelsus (+1541) called him the *Lutherus medicorum* of his time; later ages have considered him a reformer: he deserves both these names, if we consider, as they were wont, the writings of Hippocrates as the Bible of the physician. Like his great cotemporary Luther, Paracelsus had first to demolish and destroy all the excrescences which had grown over the ancient and honored archives, and he who would praise, in the one, the unsparing violence with which he pursued and overthrew *priestly* stupidity and egotism, would not blame in the other, the rudeness with which he scourged the scholastic adherents of Galen and the Arabians. Both, alike, testified to the superstition of their time: if the one could wield the pen in denunciation of evil principles,

so was the other entirely justified in pronouncing disease "*einen ganzen menschen*," *an entire man*, and in seeking the arcana which should attack and destroy it. Paracelsus, like Luther, boasted that he was a German, and it is a significant fact certainly, that the Paracelsian doctrines, like the Church reformation, underwent their development almost alone on German soil.

It has been doubted whether Paracelsus was acquainted with the ancients! If we did not possess his commentaries to the aphorisms of Hippocrates, if he had not clearly expressed his opinion, "that God had commenced the fundamental inspiration of medicine by Hippocrates, and had allowed the sight of nature to be effective without obscuration," even then the contents of his doctrine must have shown us, that he not only understood Hippocrates, but had imbibed and assimilated his views; the Paracelsian pathology is the Hippocratic, as it would be, metamorphosed under the influence of the Christian monotheism and demonology, and the alchymistic doctrines of the elements.

Instead of four Empedoclesian fundamental elements or elementary qualities, appeared the three alchymistic, *mercury*, *salt*, and *sulphur*, as symbols of the *volatile*, *soluble*, and *combustible*, mingled in a unity, and concealed in the life. "As long as the three are one, health remains; but when they are separated the one putrefies, the other burns, and the third takes another course, and these are the beginnings of diseases. Diseases also proceed from arrogance, when one element becomes arrogant and separates itself from the rest." Here also is a *materia peccans*, but this morbific matter becomes vivified in the view of one to whom all things seem to have permeated as emanations from God and from the godlike spirit. If there is a spirit in all material bodies, so is he also in the morbific body; if the spirit is everywhere the highest and most creative, so is he also in disease. The transmutation of matter is accompanied by a change of a portion of the vital power, but this invisible, spiritual process is the substance of disease; the *humores* are only its products.

Hippocrates had spoken of a "divinity" which manufactured and removed morbific matter. Its analogue in the system of Paracelsus is the *archeus*, the vital principle, the alchymist in

the organism, whose business is the reception of substance, assimilation of food, and the removing of the excrement. The *archeus* struggles against death, excites all the healthy members in order to fight against disease, and removes the extraneous vitality of disease, as the chemist the impure metal from gold. By means of the *crisis* the remains of the morbific body are evacuated, and the vitality purified of the dregs adhering to it. In accordance with these ideas Paracelsus designated fevers as sanative efforts of nature, and thereby formed the germ of that comic mythos, which the succeeding age so naively developed.

We express, in the best manner, in my opinion, the relation of the pathology of Paracelsus to that of Hippocrates, when we say, that the fable is the same, but the prominent figures are different. In reference to the former, Paracelsus is a humoral pathologist; in respect to the latter, he is more, and accomplishes a transition to the modern parasitism of disease, which he well compared to a tree springing from the seed, and bearing fruit, although not exactly in the unfigurative sense of the moderns. Genuine humoral pathology, a beginning of the modern chemical medicine, is only his doctrine of the tartar, a slimy, earth precipitate from the fluids of the body, which he believed was precipitated, like the argal in wine-casks, if the process of secretion was extraordinarily excessive, and which, where it is evacuated, excites pain and mortification.

The system of Paracelsus, in a short time, found blind adherents and hostile opponents; only a few endeavored to disencumber it of its excrescences, and to amplify it. To the latter class belonged Van Helmont († 1644). The progress which theory made through him, consisted in extolling the dualistic principle, in recognising the effect of morbific causes (not of the disease itself) upon the *archeus*, and in explaining all the phenomena of disease from its disturbance, from an abnormal idea indwelling in the *archeus*. If Van Helmont's *archeus* is even more anthropomorphous than that of Paracelsus, in that from its own inquietude it excites passion and mania, and creates other symptoms, still by means of it were prepared those dynamical views of the vital force, of which a subsequent age was so proud.

In the mean time the science of anatomy, which, as we have noticed already, had been smothered in the cradle of a medical system, had grown to maturity and given existence to the beginning of an empirical physiology. From the experimental observations concerning the structure of glands was developed a theory of secretion ; from the discovery of the chyliferous and lymphatic vessels the doctrine of absorption; from the discovery of the valves of the veins and of the heart, the consequently more difficult discovery of the circulation by Harvey (1628). The history of generation and of embryonic development, comparative anatomy, and the life of the infusorial world disclosed by the microscope, produced and nourished a spirit of investigation in that prominent genius. Under these circumstances the Paracelsian medicine and philosophy of nature was not only knocked down and killed, but it expired in silence from want of sympathy; only in our days has the athletic corpse been discovered, decently laid out, and its monument erected.

As the representative of the empirical physicians of this period, we must mention Felix Plater (+ 1614), the author of the first empirical medical system wherein diseases are considered analytically, as the connexions of symptoms without regard to their internal cause, and are arranged according to the affinity of the pathological processes. What influence upon this conception the independent explanation of disease by Paracelsus, and the attempt at systematic arrangement of the natural kingdoms by Gesner (+ 1565) exercised, would be represented by a history of the modern natural historical school. Plater was a native of Switzerland, like Paracelsus and Gesner.

As at the conclusion of the first period, so here, in opposition to the exhausted dogmatism, and upon the basis of the discoveries of the natural sciences, sceptical empiricism as a philosophical system was constructed for a second time by Lord Bacon, of Verulam (+ 1626). Medicine has derived benefit from his splendid doctrines principally through their indirect influence upon the operation of the physical sciences. Still it is also indebted to their direct influence for a celebrated model of true

medical observations, Sydenham, of whom I shall speak again in the next period.

For the sake of one of those strange anachronisms, of which universal history is sometimes guilty, we have here also to mention Spinoza (+ 1677), a descendant from the Jews, but a modern philosopher. If, for once, in the perspective of a long series of centuries, the lights of our own, and of past times, may shine in contrast with each other, then would we place Spinoza, after Shelling and Hegel, as the genius who promulgated truths in a more lucid form, which by them are veiled by mythical symbolical representations in an unwieldy volume. Spinoza believed, that the idea of divinity acting according to design, will not agree with the idea of a perfect God, "because God otherwise would demand something of which he was deprived." And so also in natural philosophy, all final causes should be rejected which only have been found conformable to human egotism and ignorance.

FOURTH PERIOD.

Lord Bacon had taught the earnest of observation, but medical science was still in the good faith of youth : she saw too many ways before her, upon which the limit seemed attainable in a speedily direct course, and it was necessary that she should experience a series of undeceptions, before she could assume the prudent and circumspect step of a more mature science.

The period which lies before us, is the one in which the effects of external influences and of remedies, were considered as chemical and physical events, that is as the one or the other. The mechanical schools, in the modern sense of the word and in opposition to the vitalists, originated only from the subsequent alliance of two primarily separated and hostile lineages, the chemical and the iatro-mathematical physicians.

The chemical medicine is the third humoral pathological system; but it has only the figures, not the fable in common with the earlier ones, and even the figures have been recostumed in conformity to the age. Acids and alkalies take the place of the four Empedoclesian and the three alchymistic elements. Their

effect upon each other is compared to that of fermentation; vital spirits, similar to alcohol, are distilled in the brain; their effete parts are absorbed by the lymphatics, in which they are renovated by the acid. The chyle ferments from the food by means of the acid juice of the pancreas, and the alkali of the bile. The blood originates from the bile—is condensed in the lungs by the atmospheric salts—is qualified for its fermention in the heart, &c. These are the lineaments of the physiology of Francis de la Boë Sylvius (+ 1672), the head of the chemico-medical school. In his pathology, the expression "acrimony," *Acrimonia*, is used for the *materia peccans*, and in the same manner denoting the proximate cause of diseases. As all acrimony refers to two principal species of acid and alkali, so there are only two principal species of diseases, from the acid and alkaline acrimony; the transpositions of such acrimonia upon the solid parts, whereby spasms, pains and other symptoms arise, remind us of the theories of the *pathology* based on irritation. The indication demanded to blunt or to evacuate the acrimony; therewith alone the school thought they were prepared for all emergencies, and therefore dismissed the *archeus* together with its critical efforts. Chemical medicine had no futurity, because without interest it was neccessarily neglected for the great experimental physiological questions which agitated the age. Moreover it was attacked on its own ground by the progress of chemistry, and even, for a long time, expelled from the dominion of physiology, of which it had justly taken possession.

The iatro-mathematical physiology and medicine were the result of the advancement of natural philosophy, and principally of the discovery of the circulation of the blood, by which one of the most important functions of the organism was made accessible to physical calculations. Soon the composition of the blood was considered indifferently, and its motion became the principal object of investigation. The origin of heat was referred to friction, the difference of secretions to the proportion of the diameter to the length and curvature of the secreting vessels, and to the size of the angles by which the branches of the blood-vessels leave the trunk. Digestion was attributed alone to the grinding

force of the gastric walls; convulsions and pains to the tension and vibration of the nerves. Subsequently the optics of Newton gave rise to the ideas of undulations and oscillations of a nervous-ether.

In Italy, where Galilei had lived and suffered, originated the iatro-mathematical school. Its founder was Borelli (+ 1769) a member of the *Academia del Cimento*, a society founded by the pupils of Galilei. Borelli availed himself of the chemico-medical theories of the violent motion of the nervous fluid, to explain the final cause of motions. But under the sway of the Cartesian corpuscular philosophy, even the chemical processes must have been restored, to account for the motions of the smallest parts, for their shape and attraction. The mechanical principle reached its height in Baglivi (1706) and Keill (+ 1719), and whilst the iatro-mathematical theory was guilty of the same partiality as were in ancient times the sect of the Methodists, it degenerated like them, only with more powerful secondary effect, into the pneumatic reveries of which the following section treats.

But the mathematical severity with which the chemico-medical school treated physiology, avoided the more obscure and complicated questions of pathology. Individual views, like the doctrine of the stagnation of the blood in the valveless veins of the abdominal organs, have outlived the system: otherwise it created only a few perishable representations of the *error loci* of the humors, obstructions of the passages, &c., which were neither new, nor consistent enough to induce others. The mass of physicians devoted themselves, therefore, to an eclecticism, which is not incorrectly represented now-a-days, in the inferior histories, by the confused current expressions of repelled acrids, and relaxed nerves. At that time, with the decline of the school happened a number of more important, and for the most part new national diseases, as small-pox, dysentery, English sweating disease, typhus and scarlatina, all which combined to educate a man, who had received his philosophical prefiguration in Bacon, and his medical antitype in Hippocrates. Sydenham (+ 1689) has justly been called the "English Hippocrates," because, as he participated in the preconceived opinions of the Greeks concern-

ing the nature of disease, so he rendered them harmless by the value which he imputed to their direct therapeutic experience. He considered disease as the result of a peculiar corruption of the humors, and as an effort of nature to get rid of noxious humors, but he meant, at the same time, "that surer indications should be derived from cases where certain things had been injurious or useful, than if we were occupied with the investigation of the hidden fundamental elements." He furnished exact delineations of individual diseases, which could not be considered as illegitimate appearances: he has described them with the same care and minuteness with which we describe plants and animals, as they in the same manner form species. With every regard for scientific indications, Sydenham expected a great futurity for medicine, from the discovery of specifics, similar to what he already possessed in cinchona.

FIFTH PERIOD.

The rigid mechanism of the modern, as of the ancient solid pathologists must lead to the acknowledgment of a moving spiritual essence regulating motions: but this in the manner it originated, must appear absolute and arbitrary, as it came in like a foreign and accidental thing principally where the illustrations taken from natural philosophy, for the instant, found a limit: it might be teleological, because the age condemned Spinoza, and man in native simplicity always considered himself as a model to the Deity, and the natural forces which he formed. But religion had ploughed through the ground upon which now the pneumatic theories had fallen; not that religion which the pagan priests embellished with clandestine fraud and sold to the people as Christianity, but the Christian religion itself re-established in the utmost purity, with its longing for the substance and its contempt for the shadow, with its glorification of the spiritual, and its disdain of the earthy, lastly with its subordination of the human intellect to a not always intelligible, but always good, divine will.

The philosophy of nature of this present period was the doctrine of Leibnitz, of Monades and their pre-established har-

mony. The originators of the solid pathological pneumatic systems were, in partial opposition to each other, Frederick Hoffmann (+ 1742) and Stahl (+ 1734). It is once more to be remarked, that mechanical medicine, after it had maintained itself pure in Italy and England, consummated its development to dynamism in Germany.

Hoffmann taught that all natural bodies are endowed by God with material forces through which they execute their motions. These forces are coherence and resistance; the bodies are effective according to their number, measure, and weight. The foundation of the special activities of organic bodies lies in the accession of an ether, a material substance of peculiar subtlety, fluidity, and vivacity. In animal bodies the brain is the secreting organ of this æther, or nervous spirit, which flows to all parts through the nerves. Life depends upon the continued motion of the solid parts, particularly the heart and the dura mater. Disease consists in a defect of motion, which is either too weak or too strong. From violent motions arise spasms, which, when they operate on sensitive parts, receive the name of pains. Inflammations, hemorrhages, catarrhs, fevers, are spasms; the fever, for example, is a spasm of the external parts which drives the blood upon the internal parts. Atony arises from too slow motions. Cramp and atony, the *stricture* and *laxum* of the Methodists in a renovated form, are also the cause of the corruption of the humors, which by atony stagnate and putrefy, by cramp are retained.

Hoffmann maintained, moreover, that the æther or the soul operated according to necessary laws, although he confesses he was ignorant of those laws. On this point he insisted the more strenuously, as it was the most important point of controversy between his and the system of Stahl. Motion is, also with Stahl, the fundamental property of organic bodies, and interrupted motion, a change of the tone or property, constituted the cause or basis of disease. According to his view, the body, as such, has no power to move itself; it must be urged thereto by immaterial substances. Each motion is immaterial and a spiritual act. But he explains the soul as the moving principle,

that same original, desiring, and conceiving essence, which at death leaves its corporeal part, and abandons it to the disposal of the inorganic forces of nature. It works arbitrarily, but unconsciously, instinctively, as perhaps in the habitual, so-called arbitrary motion of walking, playing on the piano, &c., which we learn to execute without being aware of it. If all motion has its foundation in the soul, so must also the essence of disease rest in an "interrupted and confused idea of the government of the animal economy." The soul, guarding the preservation of the body and continually vigilant, endeavors to oppose every morbific cause, and from these motions and their hindrances diseases will be produced. Fever is an autocratic motion of the soul, to get rid of the irritation of fever; convulsions are the violent endeavors to remove the intruding morbific influence; in fact, according to the energy with which the soul pursues its object, arise acute or chronic diseases. Imperfect as it is, it mistakes only too often the condition of its corporeal part, errs "through impatience, precipitation, fear and care, through the depth of sorrow, improper security, through the irregular alternations of venturing and desponding, of yielding and opposing."

The sanative power of nature then perished. That friendly θεῖον of Hippocrates, which the acrimonious humors inspissated to a divine flame: the demoniacal *Archeus* of Paracelsus, who in his rage shook the fevered body, is changed by the Pietism of Halle, which Stahl also recognised, into an unworthy sinner, writhing with pains and spasms in the darkest labyrinth of the body.

It was in vain that Stahl's successors contested with regard to the union of the thinking and the organizing soul, and distinguished the latter by the names of vital principle, vital power, &c.: because upon this notion were now transferred those ideas of inefficient, useless and foolish efforts, against which we still have to contend. Henceforth the power ruling the organism became a man, but an absolute, arbitrary, weak man; henceforth physicians became genuine ministers of this autocrat, whom he led in the feeling of their superior strength and in contempt of his weakness, whilst they openly called themselves his servants; henceforth they began to look down with disdain upon

those who would dare to apply the measure of their circumscribed, chemico-physical, dependent intellect, to the operations of the sublime *vis vitalis*, appointed directly and alone by God.

A retrospective view of the past periods shows us, that it was for the most part the anatomico-physiological sciences in their successive development, by which medical systems were overthrown. The oldest humoral pathology succumbed to the beginning of Zootomy, the system of Galen to human anatomy, the system of Paracelsus to the physiological notions founded upon anatomy. A newer branch of science, the experimental physiology, had begun to develope itself since the time of Harvey, and now devoted itself to investigations, through the elaboration of which it was soon to celebrate its greatest triumphs, and give a new turn to medical theory. Contraction of the heart had been acknowledged as the first cause of the circulation: but upon the causes of contraction of the heart many different hypotheses had risen and fallen, when Haller (+ 1778) discovered convulsions in an exsected heart, and designated, with the name *irritability*, the property of muscular fibres to shorten themselves by contact, or by the application of chemical substances. Haller showed that this motive power is dependent upon the activity of the nerves, as it continued even after the nerves were cut through; that, on the other hand, nerves which are not in themselves irritable, possess the faculty, under similar mechanical or chemical invasions, of conveying impressions to the soul. This faculty he called sensibility. He taught that irritability differed from the physical power of contraction, which soon disappeared after death; but inasmuch as he acknowledged it as one peculiar to certain organic fibres, he laid the foundation of the more recent ideas of irritation and reaction. Roger was the first who stated that irritability was only the possibility, the predisposition to motion, but not its final cause. In order that motion should be effective, an external influence is necessary, the irritant. The irritation of an organ endowed with the possibility of motion, produced the effective motion, like reaction. This manner of comprehension was transferred by Darwin to the sensitive nerves: it is the foundation upon which in con-

tinual and rapidly progressive development our nervous physiology was constructed.

SIXTH PERIOD.

Hitherto it has been disputed whether irritability belongs to the muscles intrinsically, or only in connexion with their nerves; whether the irritants which occasion contractions, operate directly upon the muscular fibres, or only through the interposition of the nerves. The latter opinion, now the predominant, referred to Haller's time, or rather the common opinion which acknowledged the brain and nervous spirits as the causes of all motor and sensitive powers, was continued without fundamental discussion. The next result, therefore, of Haller's discovery was only, that attention was directed still more exclusively than in the last solid pathological theories, to the nervous system, and the solid pathology was metamorphosed into the nervous pathology. No influence upon the organism was allowed to external things, except through the nervous system; the first cause of all internal changes was sought in the irritability of the nervous system; nothing else was seen in remedies but *irritants* which operated "dynamically," by "contact" with the nerves, and by means of sympathies. But worse than this one-sided view, which nevertheless led to a correct estimate of many of the phenomena of disease, proved the union of nervous physiology with the teleology of Stahl, whereby it then happened, that to the *reaction* of the nerves was attributed the design to get rid of the *irritant*, or to maintain itself in opposition to the same. From this union originated the fever doctrines of Cullen (+ 1790). He thought that the causes of fever diminished the energy of the brain, and excited consensual atony of the skin. But at the same time, "as the reaction," the activity of the heart and of the vessels was increased. The strength of the reaction furnished the principle of classification of fevers, which consequently were divided into fever with strong reaction (*synocha*), with weak reaction (*typhus*), and with mixed reaction (*synochus*).

Brown (1788) made a more crude, therefore more consistent,

and therefore, finally, more corrupt application of the views to which Haller's doctrine of irritability had led. He generalized the muscular irritability, and condensed it to a power permeating the body. Still more: he rejected the theoretical speculations as to whether irritability might be a power or a substance, and treated it, entirely in accordance with the model of the imponderabilia in physics, as an element which could be collected, communicated, and consumed. The procession of ideas of the system of Brown, which, on account of its influence upon the modern form of nervous physiology and pathology I communicate more in detail, is the following.

Life and all its phenomena arise from the operation of certain active things upon a power of the animate body, which distinguishes it from inanimate matter. This power is excitability; it is one and the same uniformly throughout the system, and its seat is especially in the marrow of the nerves and in the substance of muscles, both of which can be comprehended under the name nervous system. By these effective things, *the exciting potencies*, excitability is put in activity, and induced to expressions of activity. The exciting potencies all are effective by irritation, they are *irritants* for the excitability; this is aroused by them wherever they may be found, throughout the whole system in equal manner. The effects of irritants upon the excitability is excitement, upon which all the phenomena of the animate body depend. Irritation is therefore the moving-spring of life, and its modifications are the sources of diseases. In this sense, according to Brown, life is to be considered, a forced condition, as it can be maintained in operation only by means of irritation. Health and disease depend only upon the degree of excitement, and therefore upon the degree of irritation. A moderate excitement determines the condition of health, and depends upon a moderate operation of irritation. Now in diseases the proportion of irritating influence is either too slight, on account of the withdrawal of a single irritant, or on account of the diminution of one or the other irritant; the consequence is slight excitement, which constitutes a principal form of diseases, the *asthenic:* or the proportion of the irritating influence is too strong, inasmuch

as the natural irritant operates with increased power and in greater quantity; the consequence is more violent excitement, and this determines the second principal form of diseases, the *sthenic* diseases. But *asthenic* diseases or the diseases of debility are still further distinguished. The effect of irritation, namely, is not merely excitement, but also at the same time deprivation of excitability: by diminished irritation therefore must not only the excitement be more slight, but also the excitability must be increased. Brown calls this condition of diminished excitement and augmented excitability, proper or direct debility. But diminished excitement may also in such a manner originate that by a too violent *irritant* the excitability becomes exhausted, so that the customary irritant shall not effect the appropriate degree of excitement. This condition therefore of diminished excitement, but at the same time of diminished excitability, is according to Brown *improper* or *indirect* debility. Accordingly, there are three sources and three corresponding species of diseases.

1. Augmented Irritation, Augmented Excitement (and, as we add, for the sake of symmetry, Diminished Excitability).—*Sthenia.*

2. Diminished Irritation, Diminished Excitement, Augmented Excitability.—*Direct Asthenia.*

3. Diminished Irritation, Diminished Excitement, Diminished Excitability.—*Indirect Asthenia.*

The mode of cure in these conditions consists in diminishing the irritation in the sthenic, in augmenting the irritation in the asthenic diseases; only with this difference, that in the *direct* asthenic diseases we begin with irritants of a low degree, as the accumulated excitability would be forthwith entirely exhausted by a greater degree, and that we very gradually ascend by stronger irritants to the usual degree of irritation; in the *indirect* asthenic diseases, on the contrary, we commence with strong irritants, as against the less irritating potencies the exhausted excitability will not react, and gradually, by lesser irritants, we descend to the usual degree.

Death ensues by the highest degree of *asthenia*, either of the

direct, when the excitability is so very much augmented that the excitement ceases, or of the *indirect*, when the excitability is so much exhausted that no more excitement is possible.

It requires but few words to point out the deficiency of this system. Brown first erred in disclaiming the simplicity of each qualitative difference of irritation. What if, to that highly gifted physician, in whose remedial treasures were accumulated opium, wine, joyful tidings, cinchona, food and warmth in gradual succession and estimated according to the degree of effect, some one had proposed to supply him the customary means of nourishment by a double portion of warmth and cheerful conversation! The cause of this ridiculous mistake lies in the misunderstood, half-approved physical method of investigation. I have mentioned that Brown found the model of his excitability in the so-called imponderabilia of natural philosophers; but, like those, he neglected to inform himself concerning their sources, which are the supporters and conductors of hypothetical matter. Actually, nothing less was necessary than a thorough comparison of its vital principle with the imponderable agents, a comparison like that undertaken in our day by J. Müller, in order to arrive at the conclusion that there are irritants which consume excitability, and others which restore it. Brown knew only the irritants of the first kind, whilst excitability may augment by deprivation of every irritant. If, therefore, in order to explain the natural death, he assumes that a certain quantity of irritability accompanies each substance, which nevertheless by moderate excitement gradually exhausts itself, then it cannot be understood how a re-convalescence can be possible after diseases, and how the once exhausted irritability could again collect itself. Death could never be caused by direct debility, because in the greatest debility, that is, in the most deficient excitement and the utmost possible accumulated excitability, the most trifling irritation would be able to cause excitement, that is, life. In fact, disease in general would be hardly imaginable; because, if it is allowed that with the same irritation the excitement is proportional to the excitability, then will always only so much as is disposable be consumed. On account of these contradictions

Brown's theory was frequently misunderstood. Long after him, and supported by his views, sthenic diseases have been spoken of as those in which the vital power is increased; it was disputed, because where there was great strength there could not be disease. But Brown's *sthenia* is not augmented strength, but augmented irritation, and even diminished strength, if we understand by the proportion of strength, the proportion of excitability. It should redound to the honor of Brown, that with practical tact, he has distinguished the true debility from that arising by excess of irritation: and notwithstanding this, there was connected subsequently with the name of indirect, rather the idea of irritable debility, the debility with greater excitability in lesser power.

As Brown explained all potencies as irritants, and acknowledged no depressing influences, so he was obliged to assert that there were no other paralyses than indirect ones, occasioned by an imperceptibly short stage of agitation. Rasori's system (*teoria di contrastimolo*) offered less violence to experience in that it distinguished the external influences corresponding to the diatheses of sthenic and asthenic, into *stimulants* and *depressants*, into irritation and counter-irritation. As for the rest, it was a tolerably true copy of the theory of Brown, and was diametrically opposed only in one, certainly extraneous, point of the latter. Brown had explained the greatest number of diseases as asthenic, and therefore he used the stimulating remedies; Rasori certifies that out of one hundred cases of disease, ninety-seven were sthenic (his disciples cancel this three per cent.), and he treated them with bloodletting and *tartarus stibiatus*.

Bunonianism prevailed only a short time; its imperfections did not escape the natural scientific criticism of learned men, of a Humboldt, Pfaff, Hufeland, Stieglitz; its only virtue, the bold denial of a *sanative power* of nature overcome by the disease, prejudiced it with a sentimental multitude. But its practical results were the most injurious to it, because the detrimental effect of irritating remedies in fevers, could not, in the course of a little observation, escape even a prejudiced eye. Thus men of practical talents, like Marcus, were metamorphosed

from adherents of Brown's theory, into its opponents, and were tending towards the empirical change of the period, when a new theory drew them into its vortex.

The eclectic-empirical compendiums of this and the immediately preceding age, the works of Sauvages, Macbride, Sagar, Vogelæus, Frank, manifest, under the influence of Linne's *Systema Naturæ*, an endeavor to reduce the accumulated mass of symptomatically divided diseases into systematic organizations, according to classes and orders.

SEVENTH PERIOD.

At the end of the last century, a revolution of physics and chemistry was caused by Lavoisier's theory of combustion, and by the discoveries of Galvani and Volta.

He who has followed the historical development of our science, will directly imagine that a new chemical medicine and iatromechanics must have been added to these events. We received a pathology from Girtanner wherein the excitability of Brown was confounded with oxygen; from Baumes, wherein diseases were arranged according to the predominance of oxygen, hydrogen, nitrogen, &c.; Trotter derived *scurvy* from deficiency, Beddoes, *consumption* from an excess of oxygen. On the other hand, the currents of nervous power were compared with those of galvanism, not only by Humboldt, with genuine physiological method, but also by Galvani, Ritter, and others, who considered the galvanic and nervous fluids identical, yea, who referred vital and morbid indications to the operation of galvanism.

All these opinions were merged in the mighty stream of hypothesis, which overwhelmed Germany from the commencement of the transcendental philosophy. This philosophy is itself a child of galvanism. Spinoza had reconciled the idealistic and the realistic views, when he demonstrated that there was one absolute divinity, which perceived our condition, at one time under the attribute of thought, at another under the attribute of expansion. But there was wanting an image to illustrate this deep thought, that it might be made accessible to the multitude, a

symbol upon which to found a worship. Electricity supplied this: an invisible, dormant power, which apparently divided itself into two opposite kinds. I think I attribute not a little importance to the philosophy, but as much to the symbols as they deserve, when I assert, that a spirit was wanting to Spinoza's doctrine of this body, in order to celebrate its resurrection, and to wander among us before the eyes of all the world.

In God, or the absolute, the philosophy of nature beholds the oneness of ideal and real, soul and body, spirit and matter. Only from the impulse of the absolute to apprehend by intuition, or to affirm and to appear in phenomena, arises the *antithesis* of the affirming and the affirmed, the ideal and the real, the soul and the body. The affirmed, incapable of containing in itself the endless conception of the whole, is on that account subjected to an incessant change; its existence is a continual vanishing away; everlasting is only the *copula*, the band which joins the individual with the unending ideality.

These principles have borne the most splendid fruits in the cultivation of natural sciences, and particularly in the observation of organic nature. First, by the recognition that force and matter, essence and form, inseparably connected together, are separated only for our abstract consideration. With this fundamental principle, which comprehends vital phenomena as the expression of the specific power of organized tissues, modern philosophy stands or falls. From these principles, secondly, proceeds the idea of a gradual development of organic beings, of the reference of the same to a common type, of which the development shall be a more or less perfect impression. Historical embryology and comparative anatomy are indebted to the creative power of this idea, if not for their existence, still for their appropriate meaning and their scientific value: this it is, which, like the vivifying breath, permeates and animates the masses which before were only a motionless aggregate of dismembered acquirements: this it is, by means of which finally, natural bodies and natural phenomena, even those of animate and inanimate nature, were united with each other in one whole; and as timidly as heretofore was rejected all that could not be

comprehended within the well-designated boundaries of individual kingdoms or classes, so joyfully do we now hail each discovery, by which the circumscribed limits of the system shall be burst through, and a transition effected between related groups.

Less profitable, from different causes, was the influence of the philosophy of nature upon pathology and practical medicine; partly on account of the more arbitrary, more rash and more unintelligible application of its principles to the explanation of facts; partly, and especially on account of its pretension to determine *à priori* the contents of the empirical sciences, from the stand-point of transcendental or absolute knowledge. Attempts to derive special phenomena from general principles could be hazarded with good results, or at least without permanent injury, in disciplines where, at one time a sufficient number of empirically ascertained facts should guide the transcendental thinker, at another, where remedies were given in order to prove whether the facts which philosophy postulated *à priori*, were as essential to nature as to the philosophical system. But such attempts are hazardous in a department where incontestable facts are scarce, and pure experiments difficult; and doubly hazardous in medicine, in which freedom of opinion is acquired so much more often by external accident than by internal appeal; in which those have always obtained the most adherents, who promise ample gain in the shortest and most convenient way; in which one can even become a dictator, without the acquirements and scientific severity, which must form the counterpoise in opposition to corrupted theorems.

The doctrine of the contrasts of ideal and real, abolished in the identity of the absolute, already sank down, in the hands of the founders of the school, to a mere form, a *schematism*, inasmuch as everywhere a trinity was sought for both contrasts, and for the unity joining them. Schelling considered the organism as the identity of the heavy and the light, or the real and the ideal in nature; to him the identity seemed absolute, or more under the predominance of the real, or of the ideal principle. These three possibilities correspond to the three dimensions of the organism: reproduction, irritability, sensibility. External

influences may cause the decided prominence of one dimension over the others. Disease may be such a change of the dimensions of the organism. According to Reil, irritability, sensibility, and reproduction are not properly the organic forces, but they are the natural forces, magnetism, electricity, and *chemismus*,* in higher potence. The vital process is a potenized galvanic process; sensibility predominates in the brain and nerves, irritability in the heart and muscles, reproduction in the abdominal viscera. The precedence of one of these factors in an organ produces disease. According to Stark, on the contrary, sensibility corresponds to the reception of irritation, irritability to reaction, reproduction to excitement. These, and many other equally arbitrary pathological systems, which have germinated in the soil of the philosophy of nature, resemble each other in that they entirely overlooked the qualitative, beyond the quantitative, differences of diseases. In this respect they hardly differ from the old and new humoral-pathological systems; instead of the elementary qualities, or the cardinal humors, or the sulphur, salt, and mercury, or the acids and mineral alkalies, or the oxygen, hydrogen, and nitrogen, now appear three abstractions, which in the same manner maintain the equilibrium in the healthy body, and in the same manner, by precedence and disproportionate combination, limit disease. Remedies and diseases are divided into three classes, according to the disturbance of sensibility, irritability, or reproduction, or according to the effect upon these forces; subdivisions are made according to the predominance of the irritability in the sensibility, in the reproduction, &c., &c.

I remarked, that by the philosophy of Schelling, a gradually progressive development of the organism was represented, from lowest to highest. This representation has also become the foundation of a pathological system. Schelling himself demanded, that the genera of diseases, as of the ideal organism, should be construed with equal precision as the genera of the

* This word "chemismus" cannot be translated: it has a more extensive signification than our English word Chemistry, or the German "chemie"—it means everything relating to Chemistry.—Trans.

real organism, and expected that both would then correspond. The physicians of his school have accomplished this in two ways.

1. As in the inferior animals, now this, now that system is pre-eminently perfected at the expense of the rest, and only to man is a certain equilibrium allowed, so the predominance of one system is considered as a degradation of the human organism to a lower grade, that which includes one or the other normal animal. Thus, for instance, man is degraded to the level of a brute, if in consequence of indigestion his tongue becomes white and his urine turbid; an abortive effort to ruminate is manifested in his eructation and vomiting. In rachitis the patient assimilates the mollusca, in dropsy the intestinal worms (Blasenwürmern), &c.

2. Diseases themselves were considered as an inferior, organic substance, the parasitic life in the organism upon which disease appeared. I have above demonstrated how the cultivated mind, by the observation of the external world and of mankind, is led to the adoption of a unity which causes the morbid-symptoms, and farther how such ideal unities according to their internal necessity, of which the history of civilization of all nations gives evidence, appear in the form of personalities. I have already called attention also to the difference, which distinguishes the development of the idea of disease, from the development of most of the ideal unities or conceptions; namely, that the most concrete, mythical perfection of disease was arrived at only by a gradual addition, whilst other ideas, born in human shape, were subsequently robbed of their human body. If we investigate the cause of this difference, we meet with a law, which, having long been recognised for the development of the individual, seems also applicable to the development of the species. A certain Dutchman asked a suitor of his daughter, if he had ever been crazy, upon the supposition that a quiet state of mind could not otherwise be acquired than after certain violent experiences. Science also seems obliged to indulge in reveries in its old age, by which it remained unaffected in its youth. It remained unaffected, as long as it was not sensible of the necessity of a connexion of special facts with general principles; it began to wander in reveries when it deemed

itself able to judge the most special facts according to its principles. It was reserved for the physicians, well-educated in the Philosophy of Nature, to complete the error, because the Philosophy of Nature, more energetically than any other one of the old philosophical systems, proceeded from general fundamental principles in the illustration of the individual.

As morbid symptoms are nothing else than the physiological functions altered by abnormal external influences, so an analogy cannot be wanting between the phenomena of normal life and the pathological process. Every one is at liberty to call the beginning of disease its birth, the end its death, and its stages its age. In so far as diseases, as reactions of a typical organism, are typical, we may distinguish their abnormal forms; if now "morbid" is the same thing as "abnormal," why should we not speak of morbid diseases? If the activity of an organ intermits in health, it may also in the condition of disease; in paroxysm and intermission we see a repetition of sleep and waking. By such resemblances, disease, even with Paracelsus, acquired the name of vitality, or a vital process, and indeed of a parasitic one; because it can only manifest itself on the living individual. Presupposing a body as the substratum of that vital process, Paracelsus likewise called disease, an organism, an animal, an entire man. But the Philosophers of Nature first investigated the question concerning the peculiar form and the generation of this morbid body; and their answers bear certainly the pretension of logic, if not always suitable calculation.

The morbid body, then, was at first proclaimed a part of those pathological formations which are the consequences of abnormal exudation and nutrition, from the pustules, blisters, tubercles, warts, &c., to the more complicated, since then called parasitic tumors. I say a part, because although between a purulent sputa and a pustule, there is no other difference, than that the pus in the one case free, is in the other effused under the epidermis, still no one has gone so far as to attribute the sputa to the living organism. Although a sediment in the urine, a stone, and an organic and organizable matter, stand in the same relation to the morbidly altered material change of which they are the products, still we consider the latter only as a body, the former on the con-

trary as the sediment or residuum of disease. At the head of diseased organisms were placed the entozoa, as the most perfect, whose animal nature we certainly cannot deny. Here two explanations are possible. The entozoa spring from eggs, which are deposited in the bodies, and developed when their fluids are adapted thereto; so disease depends either in this disposition of the fluids, or, to go farther, in the disturbances occasioned by the entozoa; the intestinal worm itself, which molests the bowels of a man, is as little a diseased organism, as the dog which bites him in the leg, or the itch-mite which burrows in his skin. On the other hand, if we must allow the spontaneous generation of the intestinal worms from the alienated matters of the body which they inhabit, then we shall have indeed a proof, that the excrementitious matter can be awakened to independent life; a fact which is expressed more obscurely in the malignant forms of parasitic tumors; but the parasite would always be the independently acquired product of the diseased body, not the disease itself. He who would maintain the latter, would be obliged to enumerate, either the vital indications of the worm, his food, his motions, his procreation as the morbid symptoms, or the pains, spasms, diarrhœas of the sick as the vital activities of the worm. What if it could be satisfactorily demonstrated that a disease, at a certain period of development, abandons the body upon which it was born, tumbles itself about briskly in water, grows and metamorphoses itself, without further molesting the patient? Will those who contend for the emancipation of disease, see anything in this but an abuse of freedom?

Yet we have still more strange permutations to observe, if we investigate the origin of the morbid organism. Some compared it to procreation without genital organs; others adopted the coition of a male and female agent: for the male factor they explained the morbific potence; for the female, now the morbid predisposition, now the body about to be diseased. These theories found an inexhaustible source of misconstrued analogies in the contagious diseases. Disease procreates! It produces a matter, which upon a new soil developes itself to the same identical disease! This offspring of disease is *contagion*, a germ or egg, and

then the disease is feminine; or it is semen which impregnates the blood, and then the disease is masculine, the impregnated or the blood is feminine. The morbid organism becomes capable of procreation only at its complete development, therefore the same disease can appear before its puberty as *miasmatic*, and after the same as *contagious*. The exanthems, which make their appearance in the course of most of the contagious diseases, and usually contain the contagion, should be the parasitic organisms, or its germ-preparing organs. It has been, and I must, unfortunately, add, it is described as such in a terminology which is imitated minutely from the terminology of botany.

It is true that contagion acts like a faculty of development and reproduction of the organic body, but false that it should ever become disease in its development. However powerful and extensive it may be, it is always only the morbific cause diffused in one body and transferable to others. Not that contagion constitutes disease, but the process by which it is multiplied in the sick. Disease does not reproduce contagion, but it reproduces itself under the favorable conditions offered it in the sick body. In regard to the exanthemata, we must be blinded, in order to assign to them that character which is opposed to their similarity to the usual terminations of cutaneous inflammation after mechanical or chemical irritants. It is no excuse and of no importance in this matter that true vegetables are found in our days, of the class of fungi, growing luxuriantly on the skin, which resemble suppurating pustules in form and color. The difference is so much the more decided, and if epiphytes can be the cause of the collections of pus, then are they identical neither with the abscesses, nor with the process whose termination is in the formation of pus.

In the mean time, attention was directed, next to the disease, to the patient also. There were not many Philosophers of Nature bold enough to describe, like C. H. Schultz, the sloughing of the epidermis, as a direct process of desquamation belonging to disease. Most of them did not deny, that at least a greater part of the morbid symptoms consisted in functional disturbances of the invaded organism. In this perplexity the Archæus seemed

yet once more a protector. Why should a system which elevated disease to the rank of an animal, have not willingly connected itself with a system which degraded the *sanative power* to a humanly struggling and erring nature? Thus we see again how the consequences of a morbific influence are distributed at pleasure; how some are attributed to the animal, others to man in a state of disease. We should suppose, according to this, that a rational being would defend himself against an invading parasite by such means as headache, loss of appetite, constipation, coated tongue, &c., and in a successful event would celebrate his victory with mucus, sweat, urine, and fæces! Whilst the school still boasts that it pervades the universe with its elevated conception of life, it has already made out of our own flesh and blood a deadly battle-ground, where hostile conquerors engage! The parasite deposits his eggs in our blood, the Archæus repels them again; the parasite establishes himself in the shape of an excrescence, the Archæus cuts it off as with a ligature. If an inflammation mortifies in the centre where it is most violent, and suppurates in the circumference, then the parasite has caused the mortification, and the Archæus the circumscribing suppuration; if in the middle of an inflamed vesicle pus is formed, then the suppurating point of the vesicle is the parasite, and the red border around its base, the reaction.

Enough! It is hardly necessary to mention in conclusion that the intruding morbific irritant, that malignant and heterogeneous *noxiousness* of our modern eclectics, which is to be manufactured and transmitted, is identical with that parasite, and the reaction of the moderns with that Archæus. It is always the old fiction, only with new figures.

Haller's discoveries, from which we in Germany had hitherto been accustomed to abstract nothing but the "*sensible and irritable factors*," had, in the mean time, in France and England, brought forth more substantial fruits, which at last were also beneficial to us. By the names "*sensibility* and *irritability*," Haller had designated specific forces, which seemed to be united to organic substances, in the same manner as the appropriate forces of cohesion, elasticity, and affinity are connected to the inorganic

body. Reil had well known this important consequence, and had designed to perfect it, when the Philosophy of Nature overtook him. Bichat, from that fundamental thought, and from the material of observations collected with unwearied assiduity, created a new science, general anatomy. He taught the division of organs into tissues; that is, material parts of more peculiar construction and of appropriate forces, upon the play of which the efficiency of the organs depends. He investigated the pathological changes of the tissues, and demonstrated what Pinel had already taught in relation to the expansion of mucous membranes; that in organs most different, the same tissues may be diseased under like circumstances, and with similar symptoms and results. A more modern way, that of localizing the vital and morbid phenomena, was hereby discovered, and now particularly, the seat of general morbid processes was assigned to the general continuous tissues; the catarrhs, to the mucous membranes; rheumatism, to the fibrous structures; dropsy, to the serous membranes, &c. When subsequently the microscope was employed as an aid in the examination of the tissues; when gradually the doctrine of elementary forms developed itself from the doctrine of the tissues; when, finally, Schwann had exhibited the organic atoms, which are primarily nourished everywhere alike and by the same blood, as transformed into different structures by a peculiar energy; then also was profound attention transferred from the tissues to the cellular substance, and the cells themselves; then the conduct of the latter towards physical and chemical influences was considered, and diseases began to be referred to such influences.

Haller's investigation of irritation acquired new interest by the discovery of galvanism. From it grew the most flourishing branch of experimental physiology, the physiology of the nervous system. Le Gallois and Wilson Philip first turned attention from the nerves to the source of nervous power, the central organs; the influence of their individual parts upon the action of the heart, respiratory muscles, intestines, &c., was investigated, and finally in the doctrine of Bell, a basis has been obtained, proceeding from which neurology must become just as exact and

physical a doctrine as that of the circulation has become through Harvey's discovery.

The point of contact between the experimental natural sciences and physiology was enlarged, when Dutrochet taught to recognise a power in endosmose, which regulates the passage of compound fluids through animal membranes; when the importance, to which chemistry was elevated by Berzelius, allowed the ingredients of the blood, and the secreted humors, to be compared with each other; the change of the food, during digestion, to be traced out, yea, even artificially to prepare a fluid that had the dissolving effect of the gastric juice.

We may represent the chemical and mechanical physiologists, of the seventeenth century, under the figure of navigators, who push out from the shores of chemico-physical investigation into the ocean of medical hypothesis, in order to find some terra firma, and open a traffic. But their small island was not able to equip them for a long voyage; in the endless expanse of waters, only sparse islands, towered above, far distant from each other; peradventure, also, the daring mariners did not thoroughly understand navigation: they were shipwrecked, or perished, and were buried beneath the waves. In the course of ages, the dominion of the natural sciences became mightier; by means of the alluvion, and as the water sank down, it became enlarged; at the same time all around emerged blooming island groups of physiologico-medical experience. Already was there one entire archipelago whose inhabitants came to greet each other in a friendly manner, and occasionally, here and there, effected connexions, which were to disappoint those rash adventurers. Now was necessary only the acknowledgment of a *fait accompli*. One organizing mind was needed, in order to arrange the accomplishments of both sides for a common object, and in order to declare that all should submit themselves to one law, one method. The merit of doing this belongs to Magendie, in France, and John Müller, in Germany, besides their merits in the advancement of actual science. Müller's task was the more difficult, because he had to arouse himself and his nation from the soft, sentimental reveries of vitalism, to the rough, barren, laboriousness of the empirical

sciences. It is well known, even now, how correctly his genius guided him, when it led him away beyond general principles, directly to a rigid physico-chemical treatment of details, so that the lights, suddenly blending from all sides, fell upon the eyes drunk with sleep. But it so happened, that, whilst physiology, in the above manner, developed itself, and gained in actual substance, the teleological doctrine of reaction grew profound, and at the same time continued to fix upon the functions of the nerves the suspicion of tendencies expelling irritation, and defending themselves against the external world. If the labors of the author of this manual have produced any effect (and he has been made vain enough to think that they have), he is indebted for it to his prosaic aversion to that remnant of the Hippocratic mythos, and if he asks himself for the first motive of his apostacy from the faith, he finds it in the experience, that the nerves are effective, even without irritation, and without external excitement; accordingly, that the irritant does not arouse, but only changes the function, because it changes the substance. Upon this subject, however, I shall have to enlarge in the text.

Corresponding to the anatomical and experimental tendency of physiology, which, as has been shown above, attaches itself to Haller's doctrine, an anatomical and a physiological method developed itself in pathology; the first in France, under Bichat's immediate influence, the second, principally in England, where the patriotic jubilee over Harvey's victory had not yet subsided. The first, after a rapid series of developments, gave origin to the modern empirical schools; from the other, we rational physicians derive our genus.

"Localization of disease" was the watchword of the French physicians; war was made with general diseases, and particularly with the essential fevers; a solid pathology was created, more crude than ever; the blood was not exactly considered as dead, according to their principles, but was unnoticed, because they wished to see and to touch, and did not understand how to demonstrate to the senses the changes of the blood. No one can be ignorant of the salutary results which originated from that limited view; even Broussais' violent doctrine, which crowded all

local changes into the idea of congestion and inflammation, and saw in every discolored spot of the mucous membrane the organic cause of each general disturbance, has led to significant and important discoveries; a more careful inspection of the heart and the blood-vessels, particularly of the veins, was rewarded by the discovery of a hitherto unprecedented and weighty cause of acute diseases. Already, here and there, a mass of pathologico-anatomical details were collected into an anatomical history of disease, to which they sought to refer the succession of symptoms during life. A new world was disclosed when, with this design, Laennec and Piorry taught to call in the aid of the sense of hearing, and by its intervention to investigate the condition of internal parts, which are concealed from the eye and finger.

But it was only by way of exception, and almost accidental, that these labors promoted theoretical pathology. In many cases certainly the causal connexion of organic and of functional deviations, originated spontaneously. Laennec often attempted to explain the proximate physical cause of abnormal sounds. This tendency appeared more consistently and more intelligibly among his followers, and particularly with Skoda. But in general, it is still the empirical morbid unity, the complex of symptoms, concerning which we expect account from post-mortem examinations, and from the anatomical diagnosis made in the living. Accustomed as we always are to embrace, with one word and one idea, an empirically limited group, and series of morbid phenomena, we only confound the old name, with the new one which expresses the anatomical change, or we connect with the old name the idea of an organic process, or even of a product, instead of the idea of a contiguity of symptoms. Apoplexy is no more called a sudden falling down, but extravasation of the blood, or extravasated blood; inflammation is no more the burning pain with fiery redness, but stagnation of the blood, &c. We diagnose a fatty liver as formerly, icterus; ulceration of the bowels as formerly, nervous fever; hypertrophy of the spleen as formerly, intermittent fever;—so indeed that now the real unity of a palpable deviation of form, shall explain the symptoms exactly in the same manner, as formerly did the ideal unity of one, more or less per-

sonally conceived disease. The French materialists thought, when the internal connexion was not clear to them, that at least it must necessarily happen, that the palpable change should be the cause, and disturbance of function the result; pathetic voices, as they mingled in the debate, particularly from this side of the Rhine, reminded us to consider, that dissection could only exhibit to us the results of disease. So they strove with insufficient means, without understanding each other, and without coming nearer to a decision, until the confusion had increased far enough to justify one prudent mind in calling their attention to the limits of human knowledge. This Louis did: with all the diagnostic means which the latest age had discovered, he directed all his attention to separating more rigidly the species of diseases, and according to a system, frequently used in the great social and politico-economical questions of modern nations, he sought to establish the exact value of symptoms and of remedies. But therewith pathological anatomy also renounced its pretensions to disclose the seat of diseases. The results of post mortem examinations no more furnished the key to the phenomena of disease, but only a completion of and a guide to diagnosis, an accession to the symptoms, which practically can be useful only to prove the conclusion which had been adopted during life; which proof also has the advantage of being more invariable, easier to ascertain, and more immutable.

Empirical medicine gained a peculiar reputation in Germany, because it connected itself with the predominant school of Philosophers of Nature. As Paracelsus had first called disease a parasitic organism, and Gesner had made the first attempt at classification of natural bodies, so the first natural system of diseases originated through F. Plater. The Philosophers of Nature, more decidedly than of old, had now proclaimed the independence of the morbid process; a newer, bolder flight had taken possession of the descriptive natural sciences, since the time of Jussieu, by the principle of natural classification. I consider it a speaking proof of the legitimacy of intellectual development, that under these circumstances, in medicine also the desire for a more systematic arrangement again prevailed,

as is the case with the so-called natural historical school. Nothing is more natural than this alliance of the empirical system and parasitism; because the parasitic theory fundamentally includes, only the open acknowledgment of that which the empirical tacitly presupposes, when it comprehends separate symptoms in one idea and under one name, and makes them the object of its treatment. To both, the changed functions of the sick appear as attributes, to a certain extent, as functions of disease: to the parasitist, because his speculation is supported by superficial analogies, to the empiric, because from principle he neglects the study of the body which is diseased. So Schönlein, in his vocation as a thorough practical man, embraced with eagerness those theoretical errors. As far as we know his system and his efficiency as a teacher, it betrays the practical man, by the zeal with which he has endeavored to make use of every new aid in diagnosis for separating and limiting the species; it betrays the theorist, on the other hand, in all that has reference to the explanation of symptoms. Yea, hardly could the mythos, whose completion we have followed out in these pages, be susceptible of any farther development, after one physician had ventured to divide systematically the phenomena in each individual species, into symptoms of disease and symptoms of reaction.

I have stated that the French pathologico-anatomical school, from the beginning, wholly neglected the humors, in their attempts at localization. When Germany began to take active part in the advances of pathological anatomy, due consideration was justly bestowed upon the blood. This happened at first more from theoretic principles; the great variety of the products of exudation pointed to differences in the composition of the fluid which furnished that product; the combination or mutual exclusion of certain specific formations determined to the adoption, that these originated from similar or opposite changes in the composition of the blood. An extensive observation by dissections afterwards showed corresponding modifications in the physical characters of the blood, and of the tissues infiltrated by it; for the former, differences of quantity, coagulation, color; for the

latter, different degrees of fluidity, turgescence, greater or lesser tendency to decomposition, &c.

The distinguishing character of Rokitansky's school consists in its scientific perception and application of these relations. Its reputation was still farther increased, when, by the quantitative chemical analyses of the blood, most thoroughly made by Denis and Le Canu, it had become possible to ascertain the abnormality of the blood chemically. Rokitansky had, as it were, already prepared the departments under which this accession to the material was to be brought. Andral and Gavarret are indebted to him for the effect which their work upon the pathology of the blood excited in Germany, still more than in France.

But with all these enrichments of the science, the school remained an anatomical one, and did not get rid of those fundamental errors which had misled the solid pathological anatomists upon the barren heath of speculation. Nothing was changed, except that the unity of disease forsook its old quarters in the organs and tissues, and took up new ones in the blood. It was no more inflammation, but excess of fibrin; no more nervous fever, nor even gastro-enteritis, but albuminous crasis. There were no investigations made concerning the development of symptoms from the dyscrasy, nor of the development of dyscrasia from external causes; but, worse than this, flimsy dogmatical hypotheses were adduced concerning both. That in Vienna, under such circumstances, limited to the result of post-mortem examinations, the school could have remained at this stage of investigation, is conceivable. But it seems more strange that an Andral should have presumed to explain, with a similar alteration of the blood, so heterogeneous and complicated diseases as typhus, small-pox, scarlatina, and many others.

Let us turn to England, where, as remarked above, since the time of Harvey all inquiries into organic nature were answered experimentally. John Hunter was the first who transferred this method to the proper department of pathology. His work upon the blood, inflammation, and gun-shot wounds reveals a series of genuine natural scientific investigations concerning one of the most important morbid processes. It includes the microscopic

observations of Leeuwenhoek concerning the circulation, and those of Hewson concerning the blood-corpuscles, and adds, moreover, the investigations of Hastings, Thompson, and others. In Germany, the school of Dollinger first investigated this fruitful subject, and notwithstanding it came to conclusions which are now proved for the most part erroneous, still at that time it had established its principles so securely, that we cannot again entirely lose sight of it.

Bell investigated pathology in another way. The physiology of the nerves advanced directly with the pathology of the nerves, after the idea had been conceived of creating artificial morbid conditions, which might explain the importance of individual structures. From that time almost every new physiological fact served for the elucidation of pathological phenomena. The investigations of Flourens concerning the function of the individual parts of the brain, and Marshall Hall's theory of reflex action form epochs, the former as the foundation of a future rational pathology of the soul, the latter on account of its influence upon the doctrine of nervous sympathies.

Many similar acquisitions of modern times might be noticed, but we approach the present contents of our science, which it is the intention of this book to demonstrate. Duty will not allow me here to omit the name of one man, the physician who first in Germany, and with German fidelity, applied physiological experiments to the critical examination of general pathological opinions; I mean Stieglitz, whose pathological investigations (published in 1832) shall remain worthy of imitation on account of their method, when their substance shall have long grown obsolete.

One point more, I think, ought to be rendered conspicuous. I have shown how the pathologico-anatomical tendency was completed by means of a chemical element, and came partly in collision with it. Pathological physiology has already proceeded in the same way. If there, as it were a dumb chemical abnormality, was supposed instead of the morbific unity, so here, a fluid, chemical process is recognised as the cause of morbid symptoms. Organic chemistry has become physiological chemistry. The origin of this change lies in the discoveries of Mulder,

whereby the identity of the vegetable and animal sperm, and the common basis of all spermatic affinities, was proved. Thereby only was a theory of nutrition possible, which, on the one side, limited legitimately the faculty ascribed to the animal of forming the substances of its body; on the other side, investigated the means whereby metamorphoses of the material substances are accomplished. By the recognition of those most general fundamental principles, the physiology of the reciprocal change of matter has already gained a new and more positive form. Pathology also should promise itself abundant gain from a considerate application of those principles to the explanation of morbid processes. Would that the fruits brought to maturity in sudden heat might not hasten to a speedy decay; and, above all, would that they might not be abused to decoy us back again into the old fetters. Already in the school of Liebig, which is as ignorant of modern improvements as of the earlier errors of our science, medicine is again metamorphosed into one of those crude humoral theories which, spreading like contagion, have hitherto followed after each chemical discovery. Not even the teleological vital force would be left to us; because Liebig understands, as well as his predecessors, how to draw out from the fine tissue of organic life a few threads, in the shape of chemical processes, and then to offer us the tangled skein as the share of vitalism. A host of weak eclectics praise him, that they are once more permitted to establish themselves in their inherited ideas, which they had feared they must abandon. In opposition to this reaction, which, like every reaction, obtrudes itself violently and vehemently, and in case of necessity renders contradicting facts suspicious, or silently suppresses them, physiology is obliged to take our threatened improvements under its protection. With the inborn legitimacy of facts, physiology shall encounter the conservatism which usurps opinion: but history shall teach us to mistrust every theory, which, without paying attention to the symptoms of diseases, has the impudent boldness to express their nature with one comprehensive word.

GENERAL PATHOLOGY.

I.

DEFINITION AND NATURE OF DISEASE.

I. DEFINITION.

Nature has forced upon us the idea of normality and abnormality, when, in a series of organic and inorganic bodies, she created a majority of simultaneously, or successively existing single beings, which more or less accurately reproduce each other. Each inferior group presents itself to us in a number of specimens, each higher group in a number of the lower ones, whereby it is possible to separate certain accidental signs of single beings and of groups, from certain permanent and essential characters. From the latter we form the normality or type of the group. The extent within which these typical characters are accustomed to fluctuate in single beings of the lowest groups, as those of which the kind or variety has been recognised, is denominated individual; greater, and as experience teaches, more uncommon fluctuations, are called abnormalities. Thus, there is, for example, in respect to the accumulation of dark pigment in the eye a plus and a minus, neither of which can be considered as an exclusive normality; but there is also a minimum which must be considered abnormal, as well on account of its unfrequency as on account of its prejudicial influence upon the functions of the organ. We are constrained to adopt individual variations, as such, in their generic character, because the comparison of a sum of individualities gives none, or an insufficient decision for the one or the other; we remove abnormalities, or allow them not to be considered, where it is necessary to define

the generic character, and we commence the study of the same in order to collect them into a special cabinet of Lusus Naturæ.

There is a type of genera, classes, and species : there is within the species again, a type of gender, of age, of single points of development, and of functions, which is always determined by the majority, and is always subjected to similar deviations. What is normal to the adult, to man, may be abnormal to the child, to woman. We predict the consequences of each impression according to the type, and we call them abnormal if they prove the prediction erroneous. Finally, this mode of determining is extended even to those individuals which are changed by artificial conditions, so long only as comparison is possible. We should consider it abnormal, if men habituated to strong corporeal labor could not accomplish more than can be expected of most other individuals, or, if in a number of abnormalities, which we are accustomed to meet in connexion with each other, the one or the other should fail.

It is necessary for calculation, therefore, only to determine what may be normal and what abnormal, if we would confine ourselves to experience, and not presume to inquire into the designs of the Creator. There would, then, evidently be presented the medium measure of each development as the legitimate, and the extremes of both sides as the illegitimate measures. An adjacent consideration allows us in some cases to modify the result of rigid empiricism. As, namely, the external world never contains the fundamental cause, but always furnishes only the conditions whereby a body may develope its powers, so can it, in the most favorable case, do nothing else than provide the most favorable conditions; it can place nothing in an organism, which did not belong to it originally; it can only allow, or forbid, that all which belongs to the organic nature is realized in the fullest measure. We consider the highest step which a being has ever attained, as that which it should always reach, if external conditions did not subtractingly encroach upon it: indeed, our imagination, to which no bounds are set in the representation of quantity, roves still out beyond the empirical superlative, and calls into existence the ideal. What approximates the ideal we consider

not as abnormal, as it seldom is: only the extremely feeble eye is abnormal, not the acute one; only the unusual stupidity, not the unusual acuteness of the intellect, is abnormal.

If, in the cases adduced, we think we are able to give a reason why the result of calculation does not correspond with what our judgment demands, and accordingly, without hesitation, explain that which is customary as being less conformable to nature; then, on the other hand, there are contradictions of a similar kind, whose necessity is less obvious, and where the law, on that account, is more difficult to ascertain. There are organs, in the higher and lower animals, in which certain species of parasites are met with, often, or at least much more frequently than they are wanting. What is here normal? To the organism which harbors them, those guests appear not even necessary, in fact they sometimes become evidently injurious to it. But suppose the brooks and rivers could reason humanly, would they not think that their destiny should be, to flow along quietly and clearly, and that the fishes which stir up the mud were intruders invented for their vexation? I wish only to show, that, from our limited points of view, we should not attempt the interpretation of Nature's laws without great precaution.

As soon as reflection shall interfere in questions like those under discussion, so soon accumulate inducements to a more arbitrary and more erroneous modelling of ideas, which, peradventure, in single cases we may refer to their true sources, but cannot well arrange under general points of view. Suppose, for example, therefore, that we consider one far beyond the middle age of a life as an exquisitely normal being, on the other hand, one far above the medium height of full growth as an abnormal being—hardly any other conclusion remains, than that the one flatters our wishes, the other proves in contradiction with our tastes and our doors: not all who live long, are vigorous, not all adults who are tall, are sickly. One point, nevertheless, which is of influence upon the distribution of the predicate, so thoroughly affects the comprehension of the subject here to be discussed, that it deserves a particular mention.

The whole created world, as far as human reason extends,

shows such a conformity of the means to the end, that we, on the one hand, consider that which is customary, where it appears non-conformable to the design, as abnormal, and that which is conformable to the design, even where we cannot perceive its signification, we consider as normal; on the other hand, we refer to the department of abnormalities, all which is in opposition, no matter whether by vacillations above or below the middle worth to the correctly or incorrectly predetermined, naturally or conventionally established destination of a being or organ. So, therefore, upon the way to the ideal, the development changes itself again into an anomaly, if it ceases to accommodate itself to the given relations. If a certain acuteness and irritability of the nervous system is considered agreeable, and on that account as deservedly normal, so there is an excess, which, by the variety of more salutary, but repulsive sensations, may be inconvenient, even pernicious, and accordingly is complained of as an abnormality. We see, therefore, that the highest degrees of normality and abnormality are not diametrically opposed to each other, but may depend upon quantitatively different progression in one direction. We see, moreover, that according to the position in which an individual is placed, the reasoning concerning the conformality of means to the end proposed, or the contrary, of his conduct, must be very different: that therefore the very idea of abnormality, in a word, becomes relative.

I must finally and once for all, mention the restriction which the expression Abnormality, together with many similar ones, experiences in the popular application. The characters of language are derived primarily from the necessity of society and in reference to striking events: it excites amazement, therefore, if science, in a consistent manner, attempts to consider also the insignificant events of the same genus with those characters. Language, for example, stigmatizes with the word theft, the unlawful appropriation of another's property, but it must at the same time invent a multitude of milder words in order to express the smaller, genteel trespasses, which can be transacted without prejudice to one's public reputation. Science does not recognise these delicate considerations; at least, if it will also spare the

ear, it should not forget that the smallest like the largest is subjected to its tribunal. Because a thing is insignificant it ceases not on this account to be abnormal; and in advance, I ask the liberty to extend this word, and each specific, ever so rigid character denoting disease, to all that, which, in conformity to its nature, belongs to the same idea. Indeed, the slightest abnormality passes over again imperceptibly into those variations which I have called individual, and a mathematically strong boundary between both is, the nature of things never afterward to be restored.

The ideas healthy and sick correspond to the ideas normal and abnormal, in so far as the healthy is always also the normal, the sick the abnormal, even though it is not customary to call everything normal, healthy, and everything abnormal, sick. Normality and abnormality include, therefore, as the more important, health and disease. It remains to be demonstrated under what restrictions the former characters are transferred to the latter. A crystal which deviates from normality is not called sick; an anomaly which is inborn and continues in like manner during life, is not considered in the rule as a morbid condition; even a deformity appearing during life, a scar, the loss of a limb, &c., as soon as they become permanent, are no more disease. Lastly, identical with disease is the expression, morbid process. All this teaches, that under the term disease only those abnormal events are understood which recognise a change, an advance, a motion; the stationary are abnormalities in a narrower sense, defects, *vitia*. As with the predicate, health, so with the subject disease, it is only applicable upon conditions which are capable of an abnormal motion and development. A crystal cannot be healthy, but only normal. Because health is a motion and a process, so it includes the possibility to pass over into disease; what cannot become sick is not healthy.

Having demonstrated how the usage of language has limited the department, it still remains to explain how it oversteps these fixed limits. In the first place it reserves the names of healthy and diseased conditions to the living, as to the conceptions κατ' ἐξοχήν in motion, and denies them to the phenomena of inorganic

nature, even when a progress in the same is plainly expressed. It would not allow the weather, as changeable as it is, to be called diseased, but only in proper cases anomalous. So, then, popular opinion deceives itself with respect to the constancy of organic nature; it is only in appearance, that the defects of living organisms, in which we can perceive no more change, are permanent and fixed; in truth, they are just as changeable, that is, just as much subjected to material change, and are in the same manner newly created out of the whole every instant, as is the healthy and really diseased substance of the body: in truth, the holding fast to one pathological form, is just as much a manifestation of activity, as the progression in such a one. Upon this ground there are transitions between defects and disease, abnormalities, which sometimes remain dormant and then develope themselves in order to become disease, or to advance by degrees to good or evil. Often there are accidental contingencies, which decide upon the situation of an abnormality: the same contracted scar, which is a defect upon the skin, or on the side of a capacious cavity, is disease, in a narrow muco-membranous canal, whose calibre it injures. Finally, it depends upon this,—whether the affection becomes endurable by habit, or continually reminds one of its existence:—whether we consider it possible, or worth the trouble, to attempt a cure or not.

Now if diseases are a genus of abnormalities, which should always be surrounded with practical interest, as much as possible, then have we, without any hesitation, to transfer to this lower division what may be established for the entire class. Health is the *typical* and the *normal.* Disease the *abnormal*, with especial reference to the *organic process.* What may be *healthy*, and what *diseased*, will likewise empirically be ascertained only by way of comparison: and thus will be found the same complicated and restrictive intermingling of our prepossessions concerning the utility or conformability to design of existing arrangements, the same imperceptible transition into the insignificant, and (as time must here be brought into the calculation), the same transient disturbances of the normal condition. Abstracted from these difficulties, and the restrictions whose necessity and conse-

quence may not be mistaken for the application, we should have to define disease, *the deviation from the normal, typical*, that is, *healthy vital process*. This definition is no mere circumlocution: it teaches, that the determining of the type gives the rule for diagnosing disease. It contains not, as might at the first glance appear; a mere negation; because the *deviation is;* it is not a *non-existence*, but *another existence*. Disease is neither in that manner negative, that it is represented by the mere absence of health, nor in that manner positive, that it must be considered as something new grafted upon health; it is much rather, *instead* of health, a modification of it.

But our definition comprehends not merely enough to establish the idea of health and disease, as far as is possible; it also includes, in fact, all that can be said in general towards the establishing of these ideas. All that may be, or have been otherwise adduced for amplification, are either subjective, confused opinions concerning the uses of disease (I refer to the historical introduction), or, they are generalized representations of single results and manifestations of morbid activity, which neither are generally adopted, nor, where they are adopted, can they be authenticated. I mean the phrases, increased reaction, diminished vital force, disturbance and destruction of the equilibrium of organs and functions. Many phenomena of disease may be compared quantitatively among themselves, and with the normal—many not; and even where the comparison is instituted, the point of issue of the phenomena can be qualitatively distinguished. Likewise individual functions may stand in such relation to each other, that with the increase of the one the other diminishes; but it is not at all proved, that in the body the effective measure of power may be unchangeably the same, and only variable in respect to its distribution, or much rather it is proved, that it is not so.

II. NATURE OF DISEASE.

We have defined disease,—a deviation from the type according to which organic beings develope themselves.

Type, in its original meaning, is that law which determines the form and the reactions of natural bodies, which are represented in a majority of homogeneous individuals. Thus act the individuals of the organic races, and the crystals in the inorganic world. The expression, "it is typical," only refers to the form.

But, fundamentally, the laws of the type are only a particular title in the code of Nature. The shapelessness of hydrogen is certainly not less legitimate than the typical form of the crystals of salt, and inversely we must proceed from the belief, that Nature is bound to the laws of type with the same exactitude, as to any other of the (in a narrow sense) so-called laws of Nature. A deviation from the type, therefore, were not less than a miracle, and to determine deviations from the type, is about the same as to explain deformities and diseases for the *portenta et monstra* of the ancients.

If we firmly adhere to that confidence in the eternity and unchangeableness of Nature's laws, without which every investigation of Nature were a mere childish play, then must we directly deny the possibility of disease. We have, therefore, to seek out a stand-point, upon which the idea of disease is again analyzed, upon which disease and health meet, and necessity results to the one as to the other.

The stand-point upon which the definition of disease was founded, was limited, because we regarded not the conditions under which individuals appear, and accordingly have tacitly presupposed them equal. If it may be assumed, that two individuals of the same species, under entirely equal relations, could prove different, then they exceed the law; then the power which created them were absolute and incommensurable. Reason and experience stand opposed. In general the nature of one species maintains itself against the same influences in the same manner, and for the individual exceptions we find sufficient account in the difficulty of arranging all conditions completely equal, among so complicated relations. The whole practical medicine, in spite of all concessions which it has inconsiderately thought it must make, depends still upon the supposition, that the autocracy of the organism should be at least a legitimately limited one.

If we consider a man fixed and furnished with all which his own and his predecessor's events have effected in him, and compare him with the majority of his generic relations, who may have been under intermediate compensating influences, then we may find him diseased; but if we bring into consideration the circumstances under which he is perfected, then must we recognise him as normal, i. e., we must allow that every being of his genus would become exactly so under equal influences. Only because we are generally unable to bring these circumstances into calculation, even the theoretical consideration remains superficial. In individual cases, where the connexion is easier perceived, we have not mistaken the correct opinion. We do not consider unusual vital indications as morbid, when we have recognised them as the immediate and necessarily resulting consequences of a usual morbific influence; the pain from a wound, the paralysis from narcosis, are not disease, but "normal reaction." It would be morbid or abnormal, in such a case not to feel pain, not to be narcotised. The physician would pronounce an individual who has lost the power over his tongue and his limbs, and is delirious, as healthy, and would leave him instantly, unless the smell of his breath and some empty bottles in his room afforded him insight into the cause of his disease !*

It lies not in the matter, but in the spirit to which physics and chemistry are accustomed, that they remain proof against similar errors. Should we, for instance, determine the condition in which water is at 0° as the normal condition, then could the fluid water be equally well represented as diseased ice, the melting as disease, and the reaction of the water as a morbid symptom of the ice, instead of considering, as we do, the relation of water at different temperatures as of equal importance in its physiological history. Let us pursue the same course in organic physical science! Let us recognise as the cause of disease, instead of abnormal reaction, and equal conditions, legitimate reaction and alternate conditions! Either this principle is correct, or scientific medicine is a chimera.

* In other words, a man suffering from mania-a-potu, is not in an abnormal condition.

Disease is abnormal reaction, according to its phenomena: pain, as it appears in inflammation, is an unusual condition; according to its nature it is normal reaction: it is in the nature of healthy nerves to experience pain upon pressure, however applied. It can appear strange only to medical logic, if I assert, that each so-called morbid manifestation corresponds exactly to its external cause. "Is then," objects one to me, "the irritability in inflammation evidently increased; does the same catarrhal attack produce in one odontalgia, in another diarrhœa?" I will illustrate and vindicate the meaning of my assertion by a simple example. The eye is determined to the perception of light by elementary light, also by many other influences, for instance, pressure. We will suppose the customary daylight $= a$, the light of the sun as more violent, $= 2a$; now most eyes endure well the irritant a, but will be dazzled by $2a$. We meet with an eye which is already dazzled by a, and we call it abnormal. Suppose that that eye should receive from another unknown quarter, perhaps from mechanical or chemical impulse, an impression which corresponds to the amount of light a, then indeed the sum of irritation which it has to endure is likewise $= 2a$, and it must of course be dazzled the same as the normal eye. In the same manner is explained the case, where by apparently equal causes, different processes are brought about. In the one case, the catarrhal attack operates in conjunction with a morbific influence, which already existed before the vitality of the dental nerves, in the other, in connexion with a morbific influence which changed the condition of the intestinal mucous membrane. So therefore was the product abnormal, only because we compared it with one part of the causes, namely, with the last; it is proved normal and necessary, as soon as we take all the causes together. The condition which we call morbid in regard to its conduct towards a new irritant, is the normal in reference to the former irritant. If, in every disease, we see the effects of old or new causes, as must be confessed, then, either there is no abnormal reaction, or each vital manifestation is abnormal, which does not entirely and alone spring out of the original power of the organism.

I gave the name Type to the law which determines the form of natural bodies. This form can only be gained by motion and connexion of material elements; a decision which is proved to be correct by daily observation, if we are abstracted from the first creation as something inscrutable. As often as we will, we may see the atoms of bodies, from the fluid condition, arrange themselves according to certain lines and planes; organisms continually forcing the matters taken up at random into new forms.

That which loosens matter from the connexions in which it is at rest, gives it motion, and transfers it to new connexions, must be a force or a number of forces. Without a farther examination of this question here, we may be permitted to connect with the idea of type, according to which the form of the individual is adjusted, the idea of a force or sum of forces, which occasions and directs the motions necessary to the realization and maintaining of that form. Herein we proceed according to the acknowledged and tested principles of natural philosophy, which in like manner explain the highest laws by forces: the law of gravitation by a force of gravity; the law of cohesion by a cohesive force. We proceed teleologically, only in so far as the representation of effort is inseparable from the representation of force. The force of gravity also only translates the law of gravitation in the representation of a tendency of the body towards the centre of the earth: the type, considered as a force, is the property and at the same time the effort of certain bodies to attract matter in certain forms and combinations. But whether the typical force may be a simple one, or the result of the co-operating forces of certain combinations of inanimate matter, is, as has been said, indifferent to the next discussion. We may calculate the motive power of a machine, and the resistance which it overcomes, although it is well known that it is nothing else than the consequence of cohesion, elasticity, gravitation, &c.

The typical force, like all forces that can be expressed and calculated, is restricted to matter, even if it may not be reduced to so simple an expression, or so contracted to a unity, as perhaps the specific weight or the specific caloric of inanimate matter. There are, for each specific type, extremes of extent

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which relate to space; for the organism, extremes of extent which relate to time, neither of which are to be exceeded: there is for each species of organic nature a typical, although within a certain extent vacillating, rapidity of the functions of nourishment, respiration, circulation, reproduction, &c. The cause of these differences is precisely as mysterious, and no more so, than the cause, why one material melts at this, another at that temperature; why iron is hard, and lead soft; copper red, and gold yellow.

The typical force, in the great universe, in which it attains its development, is limited by other forces, being exalted and depressed like any other force which is bound to matter. The force of gravity antagonizes elasticity and cohesion; the cohesive force, gravity. Thus the typical form of the crystal is destroyed by pressure, heat, and chemical attraction (solution), and undergoes the most various modifications, according as it is obtained by a rapid or slow process; by sublimation or precipitation; from this or that menstruum; by the presence of this or that matter. In the same manner, and not otherwise, is the organic individual in conflict with other crude and subtle, inorganic, and typical natural forces; he conquers or is conquered; maintains himself or perishes, according to the specific measure of resistance suitable to each species. To the metal, it is certainly not of less consequence to maintain its elasticity, than to the animal his life: both endure certain impressions without disturbance; both change their properties under certain conditions; both lose them, temporarily or permanently, under other conditions. No one of these phenomena is less legitimate, less necessary, or less suitable than the others.

In consequence of this struggle of the typical force with foreign forces, the individual is every instant only the product of both. What it would be by virtue of the typical force alone, could not be ascertained except by allowing it to develope itself, to and for itself, without any influence of external momenta. We would thus, if the word should have any sense, learn its absolute normality. But that would be precisely the same as if one, in order to investigate the pure quality of a mate-

rial which is changed by temperature, should demand that we become acquainted with it destitute of all temperature. To be sure, among the influences to which typical bodies are exposed, such may be distinguished as are necessary to the development; others which are superfluous and accidental. The means of nourishment, for instance, belong to the first, allurements of the senses to the second class. We could represent an organism as absolutely normal, to which exactly the necessary sum of necessary influences, and no accidental ones, had fallen to its lot. But the same world which offers it to the former, exempts it not from the latter. Has God permitted this, because it could not be otherwise according to his plan of creation, or is it our destiny that the senses should become perfected by contact with the external things around us? A question, to which physiology must remain indebted for the answer.

But upon this ground also, we arrive only at the establishing of a relative normality, as that form which the typical force represents under the usual conditions. Disease is the departure from this relative normality; but the nature of disease is: The manifestation of the typical force under unusual conditions.

III. THE MORBID PROCESS.

According to the foregoing explanation of the nature of disease, all knowledge of morbid processes depends upon a discernment of the nature and mode of action of the typical force. All bodies of the same genus react against identical influences in the same manner; all peculiarities which bodies of different genera show under identical influences must at last be referred to peculiarities of their type. So, therefore, even in the relations of the type which distinguishes organic from inorganic bodies, we have to seek the cause, that only with the former anomalies are represented as processes.

But, firstly, I must express my opinion concerning the relation of the idea, which I connect to the typical force of the organism, to the idea of vital force, by which is usually denoted the first cause of the development and reactions of organic nature. The

vital force is the general; it will be the common source of all events referring to the organic kingdoms. The *typical* force is *specific ;* it explains only the special phenomena, which we always see occurring with special material substances. The former contains the cause why an egg is developed under the influence of caloric; the latter, the reason why it is developed to this or that particular organism. There is only one vital force, but just as many typical forces as there are empirically limited genera of animals and plants. Now in so far as every such hypothesis endeavors to correspond closely to human necessity, to derive the material action from an ideal will, so is it just as little opposed to the adoption of the vital force, as to the adoption of the typical forces. But if we, upon a more mature stage of the investigation, connect with the natural forces, at the same time, the notion of a necessary and legitimate efficacy (if it is even the legitimacy in which we find satisfaction as a fundamental basis of explanation): then will the hypothesis of the vital force, as it has hitherto been treated, be inadmissible ; it explains nothing real, because, itself boundless, it could explain all possibilities ; it vindicates no truth, because it excludes no possibility. But the hypothesis of the typical forces accomplishes all this. Chemistry preliminarily cuts short each inquiry into the cause of reactions of a preparation, with the explanation, that the preparation of this or that body should be a substance which has exhibited, everywhere and at all times, the same reactions ; it considers it neither necessary nor advantageous to recur to a general reactive force, whose effluence should be the reactions of individual parts of matter. We cannot demand more, and should not demand less of the organic natural sciences. If I call an individual, "man," if I attribute to a body the typical forces of the human species, that is, the faculty to develope itself humanly, then, it is true, I may be content to know whence comes this typical force ; but on the other hand I know how and to what extent it must necessarily operate.

The knowledge of the typical force of one species allows a conclusion *à priori* for the individuals of the same species, but not for others. In so far as all are formed from certain similar

materials, they sometimes coincide in certain points of their behavior, but from the duration of life, the faculty of reproduction, the necessity of respiration, &c., of one species, the corresponding relations can be as little calculated for another, as from the given specific weights of a number of metals, the specific weight of a new one could be calculated. By way of analysis, on the other hand, it becomes possible to associate the types of species under common points of view, and thus to ascend to the type of genus, class, and kingdom ; by progressive abstraction the individual becomes a mammiferous animal, an animal, and finally a living human being. But if the general idea of the living denotes a force engendering the living or inherent in the same, then it should be remembered that, consistently, a creative force must also be ascribed to the inferior abstractions of a class, family, &c. For the same reason that we determine a vital force, we should determine an animal and plant force, a monocotyledon force, &c. To this course of proceeding one would have a perfect right, in my opinion, who should represent to himself either an original matter, endowed merely with the general characters of the types of the higher and highest divisions, from which by conflict with the external world the lower groups were produced, or, should connect with the idea of a class, family, or order, the same representation of an immaterial, creative principle, as with the idea of the Deity. The latter, as readily appears without farther deduction, would lead to the most singular kind of polytheism ; the former were a not only unsupported, but a senseless hypothesis. Still no certain fact has testified to the common origin of the related, much less of the heterogeneous races, and if, notwithstanding the organism of the first periods of our terrestrial body should have been more crude, more simple, or less various than it now is, then certainly this is not to be understood as proving that one absolute plant, or one absolute mammiferous animal had ever existed without the most limited specific characters.

Our typical force is related, therefore, to the so-called vital force, in the same manner as force in the sense of physics, which is the expression of the activity of matter, to pure abstract

ideas. God, the only primitive force independent of matter, which we must adopt in order to render intelligible the existence of matter together with its forces, could, out of nothing, or out of chaos, just as well create the progenitors of all species, as he could one substance only, in general fitted for organic life: it is a delusion to imagine that the unsearchable work of Creation is better comprehended under this latter acceptation. With the given matter of organic races their forces are propagated. Formed according to one idea, these races may be compared among one another. The last abstract notion is the type of the living; it points out also that which is common to all the typical forces, but includes not, on that account, the whole of the typical forces, and therefore cannot be used for the explanation of single typical phenomena. So have we (if, in conclusion, I may be allowed to use a trivial comparison for the sake of elucidation), the idea of clothing for the feet, from which all boots and shoes have originated, and to which they are all referred; but this idea alone, although it is repeated in every shoe, explains neither its form, nor size, nor durableness; or, like the vital force, it explains all; because, in reference to the special it is indefinite, and on that account from every side ascertainable. But the necessity of understanding the particular form of the individual shoe and its uses, renders necessary a knowledge of the specific functions and materials pertaining to it.

We speak, therefore, of a typical force of species, but only of a type of classes, and natural kingdoms. We would also describe that, wherein all typical forces of organic species coincide, not as the peculiar character of the vital force, but as the common character of organic typical forces, and then, returning to our task, we would describe this character, in comparison with the common character of the typical forces of the inorganic natural kingdoms. It belongs not (as is well understood), thereupon, to establish differences between man and beings which come near to man, and any inanimate matter. The line of demarcation must rather be drawn between the lowest and simplest organisms, and the highest structures of inanimate nature. But then, neither is the organization and reference of

parts to the whole, nor the conformability to design, a distinguishing characteristic of organic nature; because the lowest plants and animals have no organs of motion, and each part of the dismembered polyp is equally capable of reproducing the whole, and with regard to the conformability to design I need not again in detail mention, that we exactly know neither the design of organic, nor of inorganic nature; that nature produces many things which appear to us not adapted to the end proposed, or at least, devoid of purpose; many things fail, which we have considered as conformable to design, and that nature must have therefore, in every case, besides the causes recognised by us, other still binding laws.

In both kingdoms, the inorganic and the organic, there appear shapeless, fluid substances, from which bodies of determinate form precipitate themselves: there, mostly crystals, still also globules, membranes, fibres; here, mostly globules, fibres, pustules, still also genuine crystalline structures. All these forms are legitimate; animate and inanimate substance strives to accomplish its object, the representation of this legitimate form, with equal necessity and with equal spontaneity, that is, from internal destination. For crystals, as for cells, there is, even under the most favorable conditions, an extreme of increase, when it vacillates, in the former within more extended limits than in the latter. Crystals collect themselves together, like cells, to an aggregate, which in most cases, by their tree-shaped arrangement, reminds us of the arrangement of the elementary parts in the higher plants. Animate and inanimate bodies oppose to external influences a certain measurable resistance, accommodating themselves to circumstances, or giving up their form. The most significant coincidence between crystals and individuals of the organic world, is shown in the conduct of both after injuries, by external attack. Crystals, like organic bodies, have the capability to regenerate, more or less completely, parts that are lost. There, as here, the force which formed the bodies, continues effective in the bodies, independent of the matter whose loss it survives and repairs. If a mutilated crystal be placed in a fluid, from which it can derive the same kind of

substance, then it grows indeed throughout the whole, but preeminently and rapidly upon the side where it had been broken off, so that above all the regular total form is restored; precisely in the same manner as a mutilated animal, from the nourishment he takes, reproduces parts that have perished, as far as is possible according to typical laws.

We could ascribe to crystals a faculty of assimilation, as they are able to attract homogeneous matter from a solution of different kinds of matter; we could recognise in this an event analogous to that of procreation, at least of reproduction by scions, analogous therein, that the formed crystal uses the newly attracted mass not to its own aggrandizement, but as the germ of a new individual upon its superficies. In the mean time, within this connexion already appear important differences between crystals and the organism, even the simplest, not to mention the higher, where elementary parts unite to one whole from heterogeneous forms and forces. I should wander too far into a foreign, and even to those who are native therein, a dark dominion, if I should investigate to what extent the chemical process of the living body coincides with the multiplied concentrated functions of inanimate matter, under the names of catalytic or contagious. I will notice particularly only one fundamental peculiarity of animate matter. It is certainly no mere accident, that as well the popular as the scientific language with regard to inanimate matter, treats of the form as an attribute of the matter; with regard to animate bodies, the matter as an attribute of the form; that we, for example, under the properties of a salt adduce crystallization, under the properties of a plant or an organ we adduce the chemical composition. In inanimate nature, the matter is the essential, only it is determined and unchangeable: we pursue it through all metamorphoses and connexions, and we perceive, as one of its conditions, the crystalline structure: in the animate creation, the form is the essential, in reference to which the matter is indifferent and changeable. The assimilation of a crystal depends only upon the acceleration of a process of secretion, which could result without it; it communicates a form to no matter which it had not gained for itself without the concurrence of the crystal: the assimilation of the

organism is a recoining of matter, which could not be accomplished without its influence: the typical force connected to one matter is necessary in order to the new matter. The same crude matter may be applied to different structures; from the same substance of the same blood, different organs are developed; the same cell adjusts itself according to the position in which it is placed, in this or that elementary tissue. For this reason it cannot be said of the crystal, that it grows at the expense of others: that, whereby it grows, is its own matter, and is capable of no other formation. The organism, on the contrary, lives at the expense of other bodies; the matter which it appropriates to itself, it must take from others, and steal other forms.

The character here discussed may be of service in distinguishing between animate and inanimate substance, where we cannot directly observe both, but only in their effects, and on this account I shall again allude to it.

We find, on the hitherto pursued empirical way, still another quality of animate nature, not less comprehensive, and therefore quite as substantial; we find besides the limits relating to space, also a development included within limits which relate to time. Even the formation of the crystal is also a temporarily measurable act; but it can be accelerated and retarded; it can be interrupted for a long time and afterwards again continued, without the result being changed thereby. The crystal, completed or not, maintains itself at every step of its formation, with all the typical forces belonging to it for eternal ages, if destroying influences are prevented. If by means of external influences it is annihilated, melted, or dissolved, it still restores itself again as soon as those influences have ceased: the inanimate body is immortal. The animate is mortal. Not only its structure, but its whole existence consists of forces of development, in such a way connected to each other, that it has every moment only the alternative to progress, or to terminate for ever. Even the simplest of all creations, the fungus arising from fomentation, loses for ever the faculty to germinate, if its nourishment fails at the time when it should form the germ. If the legitimate historical process is for once interrupted, then it succeeds only by remote

mechanical or chemical agents, in preserving the form and matter, after the manner of inanimate bodies. But even in the most favorable case, surrounded by all promoting circumstances, the organism reaches its typically fixed limit, not overcome by the forces of inanimate nature, but abandoned by inanimate nature.

The common characteristic of the typical forces of the organic kingdom is the constancy of form during the change of matter. Individuals are the severed shoots from the stem of a species, which stem, like a polyp-stock, always adds a new mass on the one end, whilst it dies off at the other. This relation is repeated in the reference of elementary parts to the individual, visibly in the tissues grown by apposition in one matrix, the epidermis, hair, nails, &c. It is repeated, finally, in the relation of the ingredients to the histological elementary forms. No tissue maintains itself, if the conditions for the renewal of its substance are withdrawn from it; this, in the organs whose function is visible motion, or subjectively perceptible sensation, is shown immediately by cessation of function; in others, whose destiny seems to be only quiet vegetation, it manifests itself at a later period by mortification, desiccation, and decay.

Nothing is more short-sighted than to seek for the cause of this perishableness of organic matter, in the destroying influence of external agents. It is true that the organism can be destroyed by attacks from without; that its own voluntary destruction can be hastened; but if death depends alone upon such influences, then nothing further were necessary than to exclude them in order to have endless life. It is equally incorrect if we represent the activity of the organism as the cause whereby the matter is worn out. The activity is not a cause, but a result of the motion of matter, a motion which, from the beginning, is bound to the typical form of the organism, in the same manner as the *vis inertiæ* to the typical form of the crystal.

The law, that the living substance should exist in a continual perishing and renewal, undergoes some restrictions and even exceptions. If the function of the brain ceases from deficiency of arterial blood, death does not immediately appear, but there follows a period during which the organ is capable of resuscita-

tion; it is only apparently dead. Single nerves and muscles which are paralysed by being tied, can be aroused to life again if the ligature is loosened soon enough. Separated parts of the body, or blood drawn from a vein, continue likewise in a stage of apparent death, notwithstanding they are still capable of entering into organic connexion with the organism from which they have been taken, or with one allied to it. The duration of this stage, like the velocity of the reciprocal change of matter generally, is different for different tissues and organisms. In general, with the higher animals, it is quite limited, and perhaps still more limited than appears at the first glance, because in the paralysed, and even in dissevered parts, the change of matter does not immediately cease, but is only reduced to a minimum. Limbs in which the circulation is interrupted, retain their power longer when the veins than when the arteries are tied; the nerves of dissevered parts of the body recover themselves, if we allow them some repose after the exhaustion by stimulants; proof that even the stagnant blood serves still a long time for nourishment.

The typical force is preserved a long time in the male seminal fluid; longest and even to an indefinite time in the eggs and germs of many animals, in the seeds, tubers, and bulbs of plants, finally in the dried up bodies of the Infusoria, Entozoa (*Tardigraden*), &c. We cannot but frankly confess, that after having passed over these individual steps, the animate matter parts with its quality, and approaches the inanimate. Truly, we say of the egg, when it perishes undeveloped, not that it is sick, or *dead*, but that it is *spoiled*. In it, if we would scientifically express the fact, the typical force is in a latent condition, and requires caloric and moisture, in order to become free and active.

According to these observations, the problem which we have assigned ourselves is solved in a very simple manner.

Anomalies are explained as "manifestations of the typical forces under extraordinary conditions;" from the peculiarities of the type of organic beings should be explained why among these anomalies only are represented as diseases or morbid processes. We find that the matter of animate bodies is in constant

fluxion; that the loss and renewal of substance is a fundamental character of the living. It is not singular that this fundamental feature should be preserved under extraordinary influences. Only as long as it maintains itself, is the individual sick; an alteration which completely annihilates it, occasions not disease, but death. Disease therefore is a process, because life is a process; if it belongs to the type of a body, to change its form or substance, then abnormal influences change it not only for the instant, but they also change its mode of transforming itself; according to the duration of their effect they divert it, for a longer or shorter time, or for ever, from the object for which it was destined. The *development* deviating from the destined *aim* is the *pathological process.*

II.

GENERAL ÆTIOLOGY.

The typical force of any given body whose history we pursue is only one of many kinds of typical forces, upon whose co-operation natural phenomena depend.

If we believe that the typical force furnishes a stand-point, from which this co-operation appears like one harmonious action, and the whole creation like one well-ordered organism; then, indeed, it must be confessed such a stand-point is not to be attained with our present actual knowledge and acquirements, and a certain understanding of facts is even possible without it. To our limited view, the typical forces of animate and inanimate bodies rather appear in a conflict among themselves and with the so-called natural forces, which will never be settled without sacrifice of the one or other side.

We may bring each body to the medium point of our observation, and everything else beyond it we may call the external world.

The external world, i. e., the totality of all the forces which affect the body advanced to the medium point, is that with which the body is considered in conflict. To a certain extent, a mutual change takes place in this conflict; we disregard the change of the external world, and are only interested in that which the body, its opponent, undergoes. But even this is subjected to a still different judgment. I have stated how, as one body can never be considered without all its relations to the external world, we establish as its normality that condition which it presents under determined relations, either selected according to certain circumstances, or under the usual relations. According to the extent to which external influences assist in acquiring

and maintaining the normal condition, they are considered promoting, congruent, or adapted to the purpose. On the contrary, the external world stands inimically opposed to the individual nature, whenever it happens to depart from the normal condition. The agent which accomplishes this effect, is the morbific influence (*schadlichkeit*), and for the body whose abnormality becomes disease, it is the *morbific cause.*

Hence it follows that the same force may be useful and injurious, according to the amount of its influence. It follows, further, that the idea of a morbific influence is equally as relative and transient as the idea of disease itself.

The above discussed contradictions are more rigidly discriminated in organic than in inorganic nature. A crystal *can* grow, and it does not perish if the conditions of its growth temporarily cease; an organism *must* grow, and it is destroyed if the means thereto are withdrawn even only from neglect. Hence in the one case, utility, in the other, necessity, stands opposed to the morbific influence. Abstracted from the value which the existence of the animate should have in comparison with the inanimate, we regard the claim of the former upon the external world as the more urgent. Only to the living do we ascribe necessity; the animate body is, as it were, sent into the world, partly in order to develope itself from the beginning, and to grow, partly in order to repair the continual loss. As by this means the contact of the organism with the external world becomes more intimate and more extensive, so are the opportunities for its injury accumulated.

The conditions, by virtue of which the organism, from the germ, is enabled to renovate itself and to grow, are,—the means of nourishment in the widest sense of the term, to which are also reckoned, oxygen and caloric. The former become changed in the substance of the organism; caloric is the condition of all chemical processes.

Now these necessary requisites, if they are applied in excess, are capable of becoming direct morbific influences, and deficiency of the same produces a series of peculiar morbid processes. In this case it might be said, that both factors of the material

change, the destroying and the renewing, are implicated, only that the former is always more uncertain, even if it has not such general indications as we shall shortly have occasion often to demonstrate.

But even where the vital conditions are presented in more accurate number, the relation in which they are offered gives unavoidable occasion to numberless conflicts. Nature furnishes our body with the crude materials, which the organism has not only to metamorphose into its own substance, but also to separate from their connexions; by this operation it receives much (as it were against its will) in the bargain, that is not exactly compensatory. Should the organism be accessible to matters which restore it, then it could not be reserved for those which merely change it. The nervous system is particularly exposed to impressions of the latter kind, in the service of all which needs for its maintenance more expert senses and muscles. Finally, the organism is, like matter, subjected to the general laws of matter, and restricted by them.

Proceeding upon the supposition, that the typical force operates according to immutable laws, we must recognise, as the cause of every abnormality, the influence of unusual external conditions. The foundation of every disease lies originally in the insufficient quality of the means of compensation, or in the imperfect, changing influences to which it is subjected. Morbid growths, of whatever kind they may be, are therefore originally products of the normal typical forces and of the inadequate means of compensation, or the inadequate external conditions of formation: they are, what the typical force is able to create under the given, unfavorable conditions.

In so far as the body is dependent upon external supplies, is changeable by external agents, so far it has the predisposition to be diseased. It has health and disease, both only in predisposition, because it is a growing body, and because something external must be added to it, in order that it may grow. The predisposition to be diseased is determined by the same typical force, as the predisposition to healthy development; it is the same for all individuals of one species under equal relations of age and

sex. How, notwithstanding all this, the adoption of one internal morbific agent, of one individual special predisposition, could ever have been attained, shall be hereafter discussed. But before all, it is necessary to examine the *modus operandi* of external agents, and to correct the prevailing ideas concerning them.

I. GENERAL EFFECTS OF IRRITANTS.

IRRITATION, REACTION, AND RESTITUTION.

We attribute to the living body the property to be induced, by every attack, to an expression of its peculiar activity. On account of this property we call it *irritable* or *excitable;* the influences, which are capable of arousing the dormant activity, are called *irritants;* the action itself, by which the irritation answers, and, as it were, is repelled, is called *reaction.* Powerful chemico-physical influences, as is allowed in every case, should change the organism according to the laws governing inanimate nature, and, in a certain measure, forcibly subject it to these laws: as for the rest, the nature of the *irritant* may be tolerably indifferent, the *reaction* determined more by the energy of the organ which the *irritant* comes in contact with, than by the *irritant* itself; therefore it also happens, that every organ is compelled by each irritant to make known always and only, one of the vital indications inborn in it.

I have already before protested against the mythical exposition which attributes to those reactions the design of removing the *irritant*, or of defending itself against it. In the first place, in the kingdom of the animate, as of the inanimate, the reaction is the result of the attack. In the convulsions of a muscle by galvanism, there is exactly as much opposition as in the emission of sparks by striking a flint. But the other suppositions also, from which a peculiar relation of the animate body to the external world are derived, are the results of a superficial and only partially correct mode of apprehension.

They are correct in reference to the means of compensation, or the vital irritants (*integrating irritants*, according to Müller).

These certainly arouse the dormant vitality, and furnish the conditions by virtue of which the organism developes its typical forms and forces. But there never has been any doubt directly with regard to these; and therefore it is not necessary first to prove that they are included in the vital process with their physical and chemical properties, like caloric in the play of affinities, or like oxygen in the process of combustion of inanimate substances.

With regard to the altering influences (I shall call them simply *irritants*), they are neither of themselves means of arousing vitality, nor is their direct effect upon animate bodies different from their effect upon inanimate.

No part of the body, in order to develope itself and to become in its way active, needs any other influences than those which perfect the vital conditions, and the reciprocal action of organs, continually or in periodic vacillations. Long before any one impression arrives at the senses, they shape themselves to the same form, which they subsequently qualify for the reception of specific irritants: if secured from all *irritants*, they maintain themselves, under certain hereafter-to-be-mentioned restrictions, in their *normal structure* and *composition*. The repose of the organism is only apparent; and even the instruments of animal life, the muscles, the nerves of sensation, and the brain, manifest an uninterrupted activity, even independent of the feeble activity of irritation, which in part can be perceived directly by close observation, in part can be inferred in a roundabout way.

I have called the activity in apparently reposing, unirritated organs, *tone*. With the expression *normal tone*, I denote, therefore, that slight amount of force, usually insufficient to attract attention, wherewith a matured organ, under ordinary relations, works without special external excitation. There is, for instance, in the muscle a certain degree of contraction,—in the nerves of sense a certain acuteness and discrimination of perceptions,—which looks upon consciousness as a general sensation, without distinguishing the specific sensations.

We consider the function of organs as the result of their form

and composition; the form and composition as the effect of the change of matter, whose duration and rapidity is regulated by the type. What accidentally metamorphoses the form and composition, changes the function. The metamorphosis may result in the quantitative activity becoming more slight, or more considerable than it is accustomed to be in proportion to the tone. In the latter case, the metamorphosis appears to arouse the activity, if it has before escaped notice; in reality, it only changes the same. What we call an *irritant*, is therefore an influence which, by altering the substance, changes the tone of its forces and expressions; but every chemico-physical invasion also effects the same in inanimate bodies. If we give to the living body the predicate of excitability, then we say no more than that it may be changeable, which does not distinguish it from other kinds of matter. If farther, the nature of the irritant appears indifferent—if the most different kinds of irritants seem to coincide in that they produce, according to the nature of the organs, contraction, or perception of light or sound, &c.,—then even this happens only because in the comprehension of the object, we lose sight of an intermediate member, namely, the physical and chemical change of matter. Let us suppose for a moment, that any one inorganic body esteems one property or force as essential, and observes it exclusively; then will each external potence, with which this body is capable of entering into reciprocal action, exclusively modify its essential force. For instance, the essential property of a metal may be its elasticity. Then will every influence alter nothing but the degree of elasticity. Heat will augment it; cold will diminish it. If we mix it with a substance which unites chemically with it, then will it again appear, only to heighten or to lessen the elasticity, because we only have regard to the elasticity. Or if we should consider the faculty to vibrate and to impart vibrations to the air, as the fundamental power of a string; if we would admit that it may be obstructed in continuous vibration, and that the material changes of the same were more concealed from our view than they are; then we could very easily, from the facts which may be observed, conclude, that the string has the function of vibration or of intonation; that whatever affects it only changes this function;

that heat and cold, moisture and dryness, pressure and chemical irritants, do not physically or chemically alter the string, but all serve only to change its peculiar energy, the tone. This argumentation is not difficult to refute; but in precisely the same manner do we treat with organic matters, especially with the nerves. In whatever way we may imagine the vital forces to be connected with matter, it is certain that their manifestations depend upon changes of the material substratum. The force of a nerve, by virtue of which it occasions muscular contractions, is just as easily determined by its material action as its power to refract light (color), or its force of cohesion (hardness, elasticity, &c.). The muscular nerve is not merely motor, but it is soft, white; it has a certain chemical affinity to the blood, and, among others, the property, as long as it lives, to excite muscular fibres to contractions. Mechanical irritants change its aggregate condition; chemical influences its composition, and thereby also its color, elasticity, and chemical affinity. But we observe only the alterations of one property, the motor, and say that everything which affects the muscular nerves may be only an irritant, for the purpose of producing contractions. The same may be said of the nerves of sense. We recognise nothing else in them, except a determined form of consciousness; and we experience no other changes in them, than changes of this form of consciousness.

But peradventure some one replics, that there are influences, against which the animate exclusively, organized matters peculiarly react. We hear of dynamical, of psychical irritants; and there is something of truth in this. Not every substance is adapted to enter into reciprocal relation with every other substance. Only a few acids are capable of acting upon the precious metals; there is as little matter which becomes changed by light. Therefore it is necessary to maintain in general, that no impulse operates upon the elements of the living body, which had not in any manner proved itself also as an exciting or decomposing cause in the play of inorganic elements. The so-called dynamic effects of remedies wherewith the materia medica formerly sought to extricate itself from embarrassments, are now, by a more intimate knowledge of organico-chemical events,

become superfluous; the psychical irritants are directly, neither irritants for, nor from, the soul; because the soul causes and perceives no impression, except by motions and sensations, which the organ of the soul sympathetically excites, or by which it is sympathetically excited.

One circumstance, which induces us to consider excitability as a fundamental force different from physical, chemical reactions, is the apparently varying quantity of the same. It had been taught since the time of Brown, that reaction may be the product of irritation, and of excitability; because the reaction proved at one time stronger, at another weaker, whilst the one factor, the irritant, apparently remained the same, the other factor was of necessity explained as changeable, as a force which can be accumulated and consumed, after the manner of the imponderabilia. This hypothesis originates in the error which I have already above mentioned; it is, namely, that we consider an organ already changed by external influences, in the same manner as a healthy one, and in judging of its conduct towards the last irritant, we forget that its reaction has to correspond not only to this, but also to the preceding, and concomitant irritants. The inflamed skin seems more excitable, if it cannot endure the ordinary temperature; in reality, it has, besides the last added elevation of temperature, to sustain the *irritant* of the accumulated blood: by this alone, without a new irritant, it experiences subjectively as much heat, as if it were already exposed to a high temperature. Of the two factors of reaction, it is therefore in truth not the excitability but the irritant which is changing; wherever the result of an irritation, compared with other cases, has not answered our expectations, the irritated organ was not in the supposed tranquil and typical condition; it was, by means of an additional influence, below or above the adopted tone, in a changed condition, corresponding or opposed already to the irritant. If we are not amazed, when in the balance a grain at last turns the scale against pounds, then we need also no particular explanation, why in the organism a trifling occasion may produce a disproportionately violent antagonism. These, in themselves, simple relations, become com-

plicated and difficult, only through the exhaustion which follows the irritation, and by the effect of contrasts. With regard to these I must waive preliminary observations.

Peculiarly therefore, I repeat, appear the results of a contact of the living organism with the external world, only on account of the forces which are connected to organic matter as long as it is a constituent part of an animate body. Far from seeing in the conduct towards an irritant a token of the independence of the organism, we much rather consider it as a proof of its passivity and dependence. The vital force bestows actual protection from chemical and physical invasions, and thus becomes to the living not irritable, but only a means of support. The organism has, in fact, against a direct irritant no other protection than that which also belongs to inanimate conditions; the insensibility (in a chemical sense), or the vis inertia which opposes a determined resistance to every invasion.

We are here again reminded of the difficulties which prevent a separation of the altering, from the integrating irritants. I mentioned how the vital irritants could become altering by excess. But if the altering irritants, as is evident, penetrate the substance of the organism, or influence it by chemical processes, then they become, for the time, necessary conditions of its existence; and, at all events, it will often be difficult to distinguish, what matter from the external world a body appropriates to itself from originally typical causes, what only accidentally.

But in another respect, the conduct of animate bodies towards irritants is essentially different from the conduct of inanimate bodies towards chemico-physical invasions, and this difference depends upon the fundamental character of the living, constantly to renew their substance. The fiddle string (to continue the foregoing illustrations), whose tone is elevated by the irritant mechanical pressure, continues its elevated tone as long as the pressure lasts, and the metal, that has once become elastic by alloyage, remains alloyed and elastic. But the organic body ceases to react, even though the irritation continues; and after a chemical influence has changed its matter, and elevated or

depressed its activity, still after a longer or shorter time, the normal composition, and the normal degree of activity returns. I will illustrate this process by a simple figure. Suppose man to be a vessel containing water, which is poured in at one side, as fast and as much, as flows out of the other. This water irritates man chemically, if a handful of salt is thrown into it. The water reacts upon the irritant by a salt taste primarily strong, but always weaker, and when at last the water is entirely renewed, no trace of the salt will be perceived in it. This figure, as crude as it is, is nevertheless well adapted to our case, only that here even the vessel becomes gradually changed, and is newly reproduced, under the influence of the typical force pervading the whole. An irritated organic tissue, for instance, a nervous filament, resembles the vessel; its elementary ingredients are transient, and constantly newly formed from the blood. The irritant alters the nervous filament, and its relation to the blood, but if it is not entirely destroyed, the change of matter continues, and thus the changed and reacted matter is removed in the same manner as the normal and the reposing, and the relation, as far as is possible, is restored in conformity to its original idea.

In this way it is, where the *status quo* is not already re-established after irritation by elasticity or physical resistance alone, that the disturbing force is balanced by a kind of reaction, which certainly is alone peculiar to the living organism. It is this whereby it maintains itself against the external world; not the agitation which follows irritation, but the transition to repose after the agitation. Now it is necessary that we should not denote two different processes with the same name; I shall retain the term *reaction* for the vital manifestations which are the immediate consequences of irritation, and for the after-effect, by which the organ is restored to the normal condition, I shall use the term *restitution*. The idea of independent counteraction is, therefore, once for all, to be removed from the word reaction. Reaction ought not to express more in physiology than in chemistry, namely, the phenomenon which is called forth by extraneous influence, and may be used for characterizing a body.

EXHAUSTION.

An organ fitted for continuous activity (if we for a while only regard the quantitative), may be changed by irritants in two ways: its function, compared with the normal, may be accelerated and strengthened, or retarded and weakened. A gland, for example, whose function is to secrete a determined substance, furnishes this substance, under certain circumstances, in greater or lesser quantity than in the usual condition; a muscle may contract, more or less, a nerve of sensation may be excited more or less actively than it should be in conformity to the normal tone. We call those which elevate the activity, *exciting* irritants, irritants in the narrowest sense; we have been accustomed to the expression *depressing* irritants, notwithstanding it contains a contradiction, for those influences which depress the activity. Both kinds of irritants may be effective to such a degree, that they interrupt entirely the change of matter, and divert the organic structure for ever from its destination; complete *paralysis* then appears directly only after *depressing* irritants, indirectly after the *exciting* irritants, in consequence of the most violent excitement. Both kinds resemble each other in that their effects are gradually compensated by restitution; but they differ in their more remote consequences. After *depressing* irritants, namely, restitution brings up the organ as far, or nearly as far, as to the normal activity; after *exciting* irritants, it depresses the organ not only as far, but under the tone, down to a lassitude from which it is only subsequently restored. This is already evident in the vegetative processes; every artificial acceleration of a secretion is followed by a pause, either while the organ collects new forces, or while the product of secretion, consumed even to the last grain, only slowly accumulates again. More simply and more strikingly this process appears in the functions of the nervous system, in that during the lassitude not only the free vital manifestations, but also the irritability is depressed. The necessity of this fact is not altogether obvious, from what I have communicated concerning the nature of irritation; because, if the excitement is only the expression of an alteration of the organic

matter which is again compensated in repose, then is it not yet understood, why in the first place a vacillation towards the opposite side, a relaxation, must ensue. But it becomes comprehensible when we remember that the restitution of individual parts, like that of the collective organism, is closely connected to conditions which are conveyed to it from without, and whose conveyance stands in no necessary connexion with the cause of excitement. Individual organs bear the same relation to the blood, that the organism, as a whole, bears to the vital irritants. With every faculty to react, reaction must be suppressed if the renovation of the blood is arrested, or its nourishing ingredients are consumed. Both seem to commence on the application of exciting irritants. According to a law (whose foundation must be reserved to a subsequent section), there happens to each excitement of the sensible or motor nerves, earlier or later, an enlargement of the vessel in the corresponding region, and a retardation or stagnation of the circulation in the same. From the final general exhaustion which follows the excitement of circumscribed parts, and from the increase of the necessity of nourishment by means of irritation, we conclude, that the nourishing ingredients are withdrawn from the blood in more than usual quantity by the irritated organ. We may imagine, that the *exciting influences* even thereby arouse a more lively activity, that they accelerate the reciprocal action between the organ and the vital irritants, upon which each activity depends; in other words, that they promote the attraction of the organ to the vital irritants, whilst *depressing irritants* diminish this attraction. If an irritant diminishes the affinity of the organic substance to the vital irritants, then will the decomposed matters gradually maintain the ascendency, the change of matter will become more inconsiderable, therefore also the force; thence the lassitude and paralysis. If this affinity is increased, then ensues a more rapid change of matter; the result is, strengthened function. But the source from which the nerve lives is exhaustible; its supply is limited by space and time; hence, if the affinity has been increased, if matter has been more vigorously transposed, and the function more energetic, then in the next instant the vital condi-

tions fail. The final result is the same in the operation of *exciting* and of *depressing* irritants; a more inconsiderable vital process, slight energy; but in the one case from the deficiency of new vital irritants, in the other from inability to receive the same.

If we apply this hypothesis to a class of nerves which possess the faculty of reacting in a qualitatively different manner, then we certainly arrive at hardly comprehensible consequences. In such nerves, long before the total exhaustion, a partial one appears, so that, for instance, the sensory nerve, which has become insensible to a determinate kind of impression, remains still irritable for another kind; nor only remains irritable, but becomes more irritable than it was before that first excitement. Just in the same manner, there are in the compass of almost every sensible organ, contrasting sensations, increasing the susceptibility for each other like the well known complementary colors. It is difficult to imagine that the nerve, during the reaction in the one form, withdraws a different matter from the blood than during the reaction in another form; doubly difficult, if the contrasting sensations fundamentally depend only upon different quantities of the same irritant, as, for example, the contrasting feelings of heat and cold. Just as little can it be comprehended or demonstrated, how an irritant has the power to change the nerves or the blood in such a way, that either the nerve is disposed to another kind of reaction, or some one matter is augmented and accumulated in the blood.

In spite of hindering difficulties, I think, at least for a while, it will be necessary to persist in this hypothesis, because it will prove useful in the representation of facts, and because the prevailing theories with their hazardous suppositions do not accomplish more than ours. I claim for it an indulgence which we are accustomed not to refuse even in the exact natural sciences.

Thus, gravity and the capacity of filling a vacuum, are not the only things which are wanting to the so-called imponderabilia in order to constitute them matter.

Still it has been allowed to operate with these as with matter, and they are always treated as such, in certain calculations, not-

withstanding it is confessed, that perhaps they may be only motions or forces of ponderable matter. If that which supports the nerves shows itself connected to matter, and conducts in individual relations like matter, if it is, in a word, measurable and finite, then it should be comprehended and reckoned as matter; then very little could be gained from a separation and representation of hypothetical matters. We therefore assume, that with irritation in a determined form, there is connected also a qualitatively determined change in the relation of the nerve to the vital irritants; that farther, exhaustion in any one determined form is accompanied with a consumption of determined ingredients of the blood. The reciprocal relation of contrasting irritants would then be comprehended in the following manner: among the possible reactions of a sense stand two, as light and dark, cold and warm, opposed to each other in such a manner, that the one, whilst it consumes the ingredients of the blood corresponding to it, at the same time effects an accumulation of the matter by whose connexion with the nerves the opposite reaction is produced. If, by way of example, we suppose that the optic nerve, which although in the act of its own maintenance it must necessarily metamorphose some one portion of matter into a substance capable of perceiving light, that this nerve should be induced by red light to decompose that substance, to receive one part, to reject another, and even that very part to the reception of which it would have been induced by green light, then the consequence would be, that the nerve after exposure to red light must react so much more violently against the green; yea, during the restitution, that is, the equalizing of the material change by the accurately stored up means of compensation, it would spontaneously perceive the green light.

I have above demonstrated how the irritated organ, as long as exhaustion does not appear, seems to be in a condition of heightened excitability, because the new irritant concurs with the results of former irritants. Where qualitative differences are possible, the form of excitability is forthwith determined by the existing excitement; the organ becomes specifically more

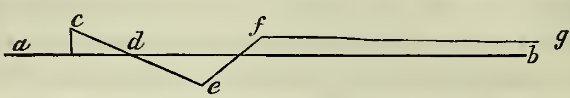
irritable for one kind of sensations, namely, for the contrasting. Here also the concurrence of a new with an already effected change in the nerve, causes the appearance of an alternating amount of excitability. The nerve, which perceives red more vividly upon green, would after a little time have spontaneously seen red; it perceives, if I may be allowed the expression, doubly red, where the *objective* is added to the *subjective*. Thus a moderate irritant becomes a violent one, if the organ which is made ready by the contrasting effect comes in contact with it.

PRACTICE, HABIT, USAGE.

The assertion, that the effect of an altering irritant would be again compensated by restitution, is not literally to be understood. It is true, it appears so, if we observe the consequence of one single irritation; but if irritations of a similar kind are often repeated in the same organ, then commence at last perceptible changes, which cannot otherwise originate than by the addition of homogeneous, imperceptible changes, after each irritation. Especially is it a result of exciting irritants when repeated, that the irritated organ shows itself more irritable, and, even without irritation, more excitable in the condition of so-called repose. If, for instance, a group of muscles is irritated agreeably to their design, and at the intervals necessary to their separation,—or, as we say in one word, if they have become practised, then the reaction follows upon a slighter impulse, and the muscles maintain, even beyond the time of arbitrary exertion, a certain preponderating degree of contraction, whereby the attitude, features, gait, &c., are determined. The tone itself becomes elevated by practice; instead of the normal, inborn, appears a more elevated, more acquired, or more habitual tone; and the result of this heightened condition of excitement is, generally, increased excitability. The effect of irritation is therefore not merely restitution, but restitution with an exaltation beyond the former measure of activity. If we designate by the line *a b* the innate tone, then the consequences of an exciting irritant are,

first, excitement as far as *c*, then gradual return to the state of repose *c d*, and under the same to *e*; then restitution and exaltation, *e f*; lastly, continuance upon this newly-acquired tone, *f g*.

Fig. 1.



Not otherwise do the sensitive nerves conduct themselves, only that as the irritation, so also the practice is one-sided. The tone of the nerves of sense, after the reparation from exciting irritants, is not, or not only absolute, but is exalted according to the determined form in which it reacted during the irritation. To a certain extent, it acquired forms of reaction, which reappear subsequently, either without occasion, or at least upon slighter inducements. The faculty of practising reactions peculiar in quality, is called memory, or the faculty of remembering.

With the acknowledgment of this fact, we here at the same time express a restriction of the law of restitution. If I said above, that the living body, after irritation, is restored, as far as possible, to the normal condition, so now, to make amends, I must add, that this is never completely possible. However difficult the proving may be in any particular case, we can in general, at least for *exciting irritants*, establish the fundamental principle, that no change of the living substance can be undone; that the restitution is never complete; and the organ remains always changed, in a slight degree, according to the part which is altered by the irritant. Experiences seem to me insufficient to decide, how *depressing* irritants conduct themselves in this respect: they are not easily applied in systematic repetition, except in conditions of irritation, where the judgment is rendered difficult by a circumstance which I will forthwith more particularly discuss.

Opposite to the law of practice, and in direct contradiction with the same, stands another fact, namely, habit. Whilst the practised organ becomes always more sensitive to the same irri-

tant—needs always smaller quantities for the development of like activity—there is a case, where the organ becomes insensible to the irritant, constantly learns to endure greater quantities of the same, and requires always a greater number of irritants, in order to arrive at the same degree of excitement. Different causes may be assigned for this exception.

It is first to be considered, that the supply of vital irritants is as indispensable a condition for the restitution as for reaction. Were they not renewed during exhaustion, no reparation were possible: were the *exciting* irritants repeated before the organ had time to restore itself, then the new irritant would find it not more excitable, but weaker; and a greater quantum of the same irritant would be necessary the second time than the first, in order to obtain a like vigorous reaction. If such an incongruity should continue, then would the exciting irritants, instead of becoming habitual by practice, become exhausted. This condition of exhaustion, in consequence of irritations too violent and following too close upon each other, we may appropriately call *excessive irritation.* It may be distinguished from simple exhaustion, which is likewise fundamentally nothing but excessive irritation, in the same manner as we distinguish a chronic affection from an acute one. Changes of a peculiar kind are developed, when every new irritant comes in contact with an already changed organ. If an organ is so far exhausted by excessive irritation, that it can no longer satisfy the demand which the organism makes upon it, then the irritation becomes a necessity. Irritants which, while they locally excite, at the same time stop the sources of restitution—for example, disturb digestion—must have that tendency, before the condition of excessive irritation. All these relations may be illustrated by the effect of spirituous liquors.

We should, secondly, endeavor to reconcile the contradiction between the law of practice, and of habit, by admitting a difference in the effect of irritants. One class of exciting irritants would be those, to which the property belonged, to leave behind a higher condition of irritation of the organs, as it were a trace of their effect; a second class would embrace exciting irritants,

to which indeed exhaustion succeeds, but no elevation of the tone, yea! after which the organ would never be elevated to the former tone. The necessity of neither of these two adopted modes of effect can be demonstrated *a priori;* each were simply *ascertained in an empirical manner.* And actually it seems as if the nature of the irritants, which, on account of their final effect, are comprehended under the name of *exciting*, was not a mere matter of indifference. Moreover with equal duration and vigor of effect, it is peradventure not the same, whether the muscle be excited by the will or by galvanism; and if we now comprehend in one class all which excites, because the different internal changes whose consequence is excitement, remain concealed from us, then is it quite time to create subdivisions, according to the way by which the irritant produces excitement, and after that to separate particularly the practised and non-practised irritants from each other. For the present, it will not be found unseasonable that I limit myself to this opinion.

Thirdly; there are cases, where the possibility of habit could be explained from the law of contrasts. The lassitude already occasioned by one continued irritant, and the indifference towards the same, in opposition to the vivacity with which the contrasting irritant is then received, is ascribed to habit. We accustom ourselves to light, temperature, sound, &c. In this sense habit is identical with lassitude, and is in the same manner conditioned by deficiency in the specific integrating irritants; the analogy between exhaustion of the muscles and habit of the senses is not immediately apparent, only because the nerve of sense seems to us passive during the reaction, and because it has the property to remain excitable for another form of irritants. Suppose, that the nerve of sense, by continued and repeated irritation in a determined form, should become, like the muscular nerve, practised, and this form of reaction should become habitual to it; then, precisely upon this ground, must the same irritant subsequently effect a slighter, the opposite or contrasting irritant a more powerful excitement. If, in general, as I have demonstrated above, the effect of a new irritation is so much more inconsiderable, the less excited the condition of the organ, then,

where the influence of contrast is added, it becomes so much slighter, the more the organ was already in the same way irritated; in other words, the more it is exhausted by this irritant, or the more it is accustomed to it.

It must happen, that the poisons and remedies, to the use of which one can accustom himself by progressive doses, belong collectively to the kingdom of plants, and for the most part to the class *narcotica*. The organism cannot accustom itself to the mineral poisons; their effect accumulates, and always corresponds to the quantity used; in reference to them, the matters of the animate body show nothing which deviates from the laws of chemistry. Habit is therefore no general appearance, no general phenomenon of irritability, no general management of nature to make noxious influences innoxious; it is acquired only by means, whose effect is evident to the nerves. The foundation of habit must therefore lie in an exclusively peculiar relation of the nerves to the irritants. The conduct towards contrasting sensations is peculiar to the nerves alone. This authorizes the attempt to explain, on the same principles, the insensibility to the narcotic poisons, and towards sensitive irritants. The first grain of opium affects the healthy body, as the first ray of light the eye accustomed to darkness. But in both cases the irritant induces a change which renders the organ more indifferent to the same irritant.

I return now to the depressing irritants, and in particular to the question, whether they, analogous to the exciting irritants, leave behind any trace of their existence; whether after their application the organ, at the place which should be changed by the irritant, remains changed, or not. As we have no experiences with regard to the methodical application of depressing potencies to the healthy organs, so we are obliged to confine ourselves to the facts which have been elicited in cases where depressing irritants have been used against chronic conditions of excitement. According to that, it appears not as if repeated depression habitually diminished the tone, as repeated excitement habitually augments it; much rather, the necessity of increasing the doses of anodyne and antispasmodic remedies, argues that

these remedies leave behind an exalted excitability. Continuing to build upon the foundation of our hypothesis, we could thus explain this fact, that the vital irritants, whose consumption is limited by the depression of the nerves, are constantly accumulating in greater quantity. Nevertheless it is easier to refer habit in the *depressing* nervous irritants, like habit in the *exciting*, to the effect of contrast.

ERETHISMUS.

At every stage of irritability and of tone, the frequently mentioned relation of the active organ to the means of compensation offers occasion to deviations, which manifest themselves as a disproportion between the energy and the duration of excitement. The rapidity with which the vital irritants are supplied and renewed, is dependent upon other conditions than the force wherewith it may attract individual parts of the body. In the rule, both increase simultaneously, and thus we gain empirically rules for the continuance corresponding to a certain strength. But a condition is possible, where the faculty of renovation falls short of the excitability ; it is particularly striking, if the excitability is normal, or more vigorous than usual: to this condition I apply the name of *erethismus, irritable debility.*

Erethism is local or general. The local can consist only in local disturbances of the conduction and motion of the fluids ; we meet with it in parts whose vascular system is affected with a particular disposition to stagnation. General erethism is founded either in similar but more general abnormality of the vessels, or in a more defective quality of the common material of renovation, the blood. By way of example I adduce preliminarily, the irritable debility after losses of blood and other fluids, and the stage of reconvalescence of the febrile diseases.

In organs which are capable of contrasting excitements, like the sensitive nerves, the erethic debility must be metamorphosed to that extent, that the organ soon exhausts itself for the one kind of reaction, and calls forth in its stead the contrasting ; that therefore the organ runs through a series of formations in rapid

succession. To this phenomenon, which certainly determines the peculiar character of many kinds of phantasma, I shall return in the symptomatology of the nervous system.

REACTION.

We have assumed that each irritation changes the relation of the irritated part to the blood; in consequence of this, the quality of the blood must be modified according to the fluctuations of the condition of excitement of individual organs, and, as the blood is the common source of nourishment of all organs, each local change must be followed by a change of the entire organism.

This change, as experience teaches, may be to a certain degree a salutary one. It appears to be of advantage to the entire body, when by a locally accelerated consumption, a more rapid renovation of the vital irritants becomes possible; by judicious labor, the general good health increases with the power of the practised organ, and with the appetite. Local excitement operates detrimentally, that is, exhaustingly, if the loss in the vital irritants cannot, or not rapidly enough, be compensated; the consequence of local irritation then, is like that of an immoderate loss of fluids, by bloodletting, secretions, &c. During this weakening and excessive irritation, the primarily irritated organ either may be likewise debilitated, or it may become practised and strengthened. In the latter case, as has been expressed, the practice of the individual part takes place at the expense of the collective organism. In order to guard against this, a uniform distribution of excitement is supplied according to dietetic rules. The neglected organs, be they many or few, are deficient in development, and this is the reason why a want of altering irritants may also become the cause of disease.

The question whether deficiency of irritation may become injurious to the collective organism in still another way, viz., by accumulation of unconsumed vital irritants, we shall, at a later period, endeavor to answer, as far as is possible, upon the ground of special experiences, by investigating the results of

interrupted secretions of blood and humors. Only for the decision of this and similar cases, I must here once more state, that with regard to the reaction, no essential difference exists between the indirect consumption of the fluids by irritation, and the direct by excretion.

II. MORBID PREDISPOSITION.

The organism, in its relation to the external world, in its dependence upon the vital irritants, in its changeableness by accidental irritants, contains the possibility of becoming diseased. In order that disease may actually exist, the operation of external influences upon the organic individual is necessary; the particular disease depends upon the particular relations of organization, and the modes of reaction of the individual, and upon the concrete nature of the external morbific influence.

For this reason we may distinguish an external and an internal *momentum*, which must coincide in order to produce a determinate form of disease.

The internal momentum, which participates in the origin of disease, is called (*krankheits-anlage*) predisposition, *seminia morborum.*

The adoption of special predispositions depends upon the experience, that the same morbific influence produces different diseases in different individuals—sometimes violent, sometimes slight, or is entirely inoperative.

But, in accordance with our supposition, a different result of the same causes cannot happen in individuals of the same species; and, as I have above demonstrated, and now must discuss more in detail, in fact does not happen. Where it has that appearance, a closer observation proves, that either the individuals which we compare are under different relations of normal formation, or under the influence of other essentially altering external causes. It is necessary to separate these two cases. While the individual, who, by virtue of the sex or age to which it belongs, reacts appropriately, is healthy—on the other hand, the individual who, on account of co-operating external influences, shows a particular disposition, is already changed by such

influences, and therefore diseased. I shall denominate the predisposition which is founded upon normal relations, *normal morbid predisposition*, and that which is founded upon antecedent external influences, *abnormal morbid predisposition;* and I shall consider each particularly. Only the former is really inborn, an hereditary portion of the race, as it issued from the hands of the Creator; the latter, the *abnormal* predisposition, is always acquired, even when it is communicated to the individual in whom it appears by procreation. The design of the first section is to place this principle of judgment in the right light; and therefore it may be considered of no importance that there are predisposing momenta, to which a definite position cannot be assigned in one of the two classes. Whether, throughout the race, the partial predispositions belong to the normal, or to the acquired, must properly remain undecided, until it shall be established, whether the variety of human races proceeds from the creation of originally different ancestors, or from the more particular development of the descendants of a single pair. Even so the opinion, concerning the position which the disposition is to acquire through temperament, is closely connected with the difficult, and perhaps never-to-be-solved questions, in how far individual, and apparently accidental differences, belong to the legitimate character of the genus.

By a misuse of the word, a predisposition of the mode of life, trade, &c., is still spoken of, in the sense that they subject the individual to exposure to certain morbific influences. Thus the potter may have the predisposition to lead-colic, the mariner to catarrhal diseases, the smith to burns, the rich to indigestion, the poor to starvation. It is obvious, that to the word predisposition, so applied, precisely that is wanting, which constitutes the essence of predisposition, namely, a condition existing in the body of the subject.

NORMAL MORBID PREDISPOSITION.

To the normal relations, which occasion peculiarities of the predisposition, belong the stages of development (age of life), the sex, and, as we temporarily assume, the race, the tempera-

ment, and similar individual characters fluctuating within the normal condition. The normal predisposition of the group concerned, is derived from a comparison of the peculiarities of reaction belonging to one species, genus, or higher class, with the reactions of other species, genera, &c.

The comparison of different predispositions, may lead to a double result. We learn,

1. That the possibility of becoming diseased, generally speaking, may be greater or less, according to the age, sex, genus, &c.
2. That certain forms of disease, exclusively or *par excellence*, are the property of a particular group.

In the first respect we distinguish the quantity, in the second the quality of the predisposition.

The quantity of the predisposition varies according to its dependence upon the vital irritants, and according to the extent of possibility of becoming changed by external influences. Its consideration has hardly any practical, and only trifling theoretical value, as no momentum can be imagined, which absolutely increases the disposition to become sick, and, by making it more sensitive to one kind of morbific influence, does not much rather diminish the sensibility for other morbific influences. The general circumstances, upon which alone it can depend, are the following:—

1. Complication of structure. The more complicated an organism is, the more numerous are the points of attack exposed to the influences of the external world. Nevertheless, it is not to be overlooked, that with the augmentation and perfection of functions, also increases the facility of obviating and compensating morbific influences.
2. The *typical* rapidity of the change of matter. The more rapidly nature requires renovation, so much more easily arise dangers from deficiency in the vital irritants—so much slighter is the force of resistance, and the tenacity of life. This is seen clearly and simply, by a comparison of the cold-blooded with the warm-blooded vertebrated animals—more obscurely by a comparison of adults with the young, as the latter, indeed, endure longer the withdrawal of oxygen, but sooner perish from

deprivation of heat and nourishment, and seem to suffer more from insufficient nutrition.

What is empirically established, by way of statistics, concerning the quantity of morbid predisposition, and the relative mortality of the different ages, sexes, and races, will be communicated in the special ætiology.

The forms of disease, from similar external causes, are determined by the organs and tissues which the morbific influence attacks; so, also, in similar organs and tissues, by the particular typical modes of reaction of the same. The proclivity to become sick in a determined form, or the *qualitative* morbid predisposition, is then dependent upon the following circumstances:

1. Upon the arrangement of the organs and systems. It is well understood, that each group is designated by anomalies of the organs which belong to it exclusively; that non-development, arrest of development, and certain defects of structure, appear as diseases only in the ages of life, where the developments are still incomplete and to be awaited, or are first perceptible in that stage of life where the organ commences its activity. It is likewise evident, that anatomically or functionally important systems enter into more manifold relation to the external world, and to the other organs, and must be pre-eminently exposed to destroying influences. In this way is explained the supposed correctness of the fact, the prevailing tendency of childhood to diseases of digestion, of youth to lung affections, of manhood to mental diseases.

2. Upon the modes of reaction. From nothing else than the external typical laws can it be explained, why the salamander reproduces entire limbs, whilst the regeneration in its kindred the frog, as in the higher animals, is limited to a few tissues; why the same wound in one species of mammalia heals by formation of a crust, in another by suppuration; why, finally, the same substance is harmless for the one species, and a poison for the other.

Similar, not farther explicable, moreover agreeing with the normal condition of the organism, are those individual peculiarities, which are designated by the name of idiosyncrasies. Per-

haps no two individuals act exactly alike in the reception of external irritants, especially through the nerves of sense; the impression of the same color upon both eyes of one individual is not entirely and completely identical, as most persons are easily convinced. Irritability and acuteness of sense seem hardly to be subjected to slighter, though always to be considered normal changes, than the color and length of the hair, the accumulation of pigment, &c. Idiosyncrasy is only the extreme of such individual vacillations.

The literature of idiosyncrasies, and a multitude of examples, are found in Stark's General Pathology. Here belongs the sensibility to determined impressions of smell or hearing, as scratches upon glass, tin, or silk, the innate repugnance to certain articles of food, and certain medicines which is expressed in direct reactions of the nerves, the cutaneous eruptions, which many, generally harmless articles of food, as oysters, crabs, strawberries, produce in some individuals. In the mean time, the department of idiosyncrasies has without doubt been very much reduced, since the affectation or imagination of the sick no longer coincides so frequently with the credulity or mania for miracles of physicians. Many idiosyncrasies of which authors speak, are probably incomplete morbid symptoms, that is, observed under isolated, striking circumstances, as the starting out of sweat upon one-half of the face after partaking of salad; many originate from the fact that all disagreeable things become intolerable to a nervous system irritable in general, or to a vehemently excited desire.

The disposition to infectious and miasmatic diseases deserves a special consideration, being as it were upon the boundary between the normal and the acquired predisposition. There are contagia, whose effect so seldom fails, that the sensibility for the same must be considered as the rule and normality, the immunity as the exception, and almost as an anomaly; the more certainly so, if by undergoing the contagious disease once, the predisposition to be made sick by the same contagium, is effaced for ever or for a long time, if therefore the immunity is acquired by means of a disease. At least it seems absurd to regard an individual patho-

logically changed, who primarily, in, or by a previously endured affection, is protected against a general cause of disease. Many epidemic diseases attack the healthy and vigorous body, par excellence, and with especial violence; they seem not only to presuppose no unusual predisposition, but even to be entirely prevented by other disease and morbid predisposition; and yet abnormal conditions of a peculiar kind, such as emotions of the mind, wounds, diarrhœas, and others, may produce a transient disposition to such epidemics. It will be observed, that the question here is, with regard to relations to a specific cause, which cannot be understood, nor at all explained without a more detailed discussion of the cause itself. On this account, the disposition to miasmatic, contagious diseases in connexion with the nature of contagium itself, will be treated of in the department of Special Ætiology.

ABNORMAL MORBID PREDISPOSITION.

The abnormal predisposition is itself disease. The expression "*affectio*," by which Gaub generally designated the predisposition, is well fitted for it.

But we may find authority for considering a condition, which is in itself already pathological, as the predisposition, in different principles, which can be united under the following points of view:

1. Disease is undeveloped, latent, without symptoms, while its appearance is connected with a certain physiological stage of development. Before this commences, the pathological formation is present only in the germ, or in the predisposition, as every physiological structure before the time of its maturity exists only in the germ or in the predisposition. But as certainly as the embryo, which in process of time becomes a human being, is human, even though we are not able to diagnose its future sex, so certainly the body, which, in order to become diseased, only awaits a determined space of time, is diseased, even though the disease cannot as yet be recognised by any particular symptoms. Anomalies in the development of the teeth, the genitals, &c., may be long predisposed, but only become evident disease when

the organs concerned begin to play their parts; the outbreak of rachitis, phthisis, cancer, and of mental diseases, sometimes through a series of generations, ensues at a certain age of life, without the possibility of discovering, previously to this period, by the most careful examination, any disease, or only a slight degree of the affection mentioned. It is only the known hereditariness of the diseases adduced, and of similar ones, that in any individual case leads to the supposition of a predisposition to the same. This kind of predisposition is the *affectio occulta* of the ancient authors.

2. The pathological condition, which is called predisposition, is evidently disease, but predisposing (*affectio prædisponens*), in reference to a condition, which is either a higher degree of the same abnormality, or an affection qualitatively different from it. Here everything depends upon the subjective mode of consideration. A morbific influence, to which the body is a long time or repeatedly exposed, and which perhaps only after years produces the destined disease, still even from the first moment changes the same. The result of the sum of all the changes is a disease. But the result of the first change is also already disease, one step in the development of the following. Now as we may comprehend, as it were establish, the condition of the growing organism at every point of its gradual development, and consider the entire structure attained at any one point, as the predisposition of the following; so may also every morbid process, which requires a certain time for its completion, be artificially divided into predisposition and disease; thus scrophulosis, itself a disease, contains a predisposition to tubercles; tubercles of the lungs predispose to inflammation of the lungs; inflammation of the lungs to hypertrophy of the heart, &c. To an individual who is costive, whose skin looks yellow, whose natural inclination is gloomy, we ascribe a bilious constitution, and a predisposition to diseases of the liver, and we would thereby express, that a disease of the liver would be developed in this individual, upon a slighter occasion than otherwise would be required. But in fact those symptoms of predisposition are already symptoms of a disease of the liver, insignificant it is true; the liver becomes

diseased more readily because it is already diseased, and from more insignificant causes because a certain quantum of causes has already operated. If a disease leaves behind the predisposition to the same disease, or, as we are accustomed to express it, to a relapse, then this is because the pathological change is not fully completed, and continues in a slight degree.

If the predisposing affection is itself disease, then the boundaries between it, and the normal predisposition cannot be more strictly drawn, than between health and disease generally, and there must be conditions which preserve the medium between both. If we compare, for example, two bodies, which, in respect to the fibrinous contents of their blood, stand on the diametrically opposite boundaries of normal variations, then we shall find that morbific influences, which are detrimental by augmentation or diminution of the quantity of fibrin, are more easily endured by the one than the other. Here, therefore, is what the specific disposition determines, a beginning, a half-way approach to disease, but only in so slight a degree, so little designated by symptoms, that it seems to us not to deserve the name disease.

The morbid predisposition has somewhat farther in common with disease, viz., that it, permanently and transiently, can be inherited or acquired after birth.

PARS MINORIS RESISTENTIÆ.

The predisposition betrays itself not only, in the comparison of different individuals, by the dissimilar reaction against similar morbific influences, but also, in the life of the individual, by the homogeneous reactions against heterogeneous morbific influences. Whoever suffers with caries of a tooth, experiences toothache from every inducement, from taking cold, from heat, from passionate excitement, from errors of diet, &c. Where a proclivity to abortion exists, it is not one irritant alone, but every irritant that is able to produce contractions of the uterus. Patients become so accustomed to a repetition of the same disturbance in the same organ, that, in every excess, in every hazardous undertaking, they dread only their headache, their spasms, their diarrhœa, as they express themselves.

Such an organ, which is attacked from all points of the body by the most varied and numerous morbific influences, was called by the ancients, the *pars* or *locus minoris resistentia*, from their idea, that every morbific influence intruding upon the body, attacks that part which is able to oppose the least resistance.

The *pars minoris resistentiæ* is an organ, which is habitually either above or below the condition of excitement of the other organs. In the first case, the effect of irritants, which otherwise would have propagated themselves equally and imperceptibly over the collective organism, is manifested in a striking manner; in the other case, it is depressed, deeper than other organs below the medium tone, by general depressing influences. In the rule, the *pars minoris resistentiæ* is a more irritable, because an already irritated part. A very good idea of this relation, to a certain extent *in parvo*, is furnished by the case, where a general shudder and horripilation, for instance, from terror or nausea, is increased to vehement pain in some ulcerated cutaneous sores, or, where with the general fever heat in local, otherwise painless exanthems, ay, even in newly-formed scars, itching and burning arise.

The excitement, whereby a part becomes pre-eminently assailable, may be physiological: there are congestions consistent with health, in organs during their development or at the time of their periodic activity, which are no more free from stagnation of blood, and inflammation, than the pathological congestion. By such processes an organ, in itself healthy, becomes the *pars minoris resistentiæ*, as is the uterus during menstruation and pregnancy, the breasts after confinement, &c. But much more often, as the above adduced examples demonstrate, the pre-eminently irritable part is one already actually diseased. The manner in which the excitement is communicated to it, will be discussed in a subsequent chapter among the sympathies.

THE HEREDITARY QUALITY.

Among the inferior animals, which are propagated by cross or lengthwise division, each individual of the new generation is, in the literal sense of the word, the half of the individual preceding it. After the division, each one of both halves has its part of

any anomaly of shape or composition, which is extended over the body of the individual: every after effect of an altering influence must likewise pervade both halves, as well as the undivided whole.

The hereditary quality is represented, not quite so evidently, but still always intuitively, in those animals, whose parts, after their separation from the whole are made entire, by the production of new organs until the animal is perfected, as in the hydra, infusoria, and others. If the assimilation whereby the severed part again becomes entire, is a function of the separated part, then the form which it obtains must depend upon the nature which it had before the separation, and thence, upon those influences to which the animal was exposed before the division. Eggs and semen are nothing else than parts severed from the fatherly or motherly body, which in different ways, but both simultaneously, conduce to the development of a new being. The egg, touched by the semen, or joined to a part of it, possesses the faculty to grow and to form organs by assimilation, partly of the yolk, partly by external nourishing substances. The product of this process of assimilation is adjusted according to the constitution of the seminal fluid, and this according to the conditions to which the parental bodies were subjected, or, what is the same thing, according to the changes which had been previously effected in the bodies of the parents.

These reflections illustrate and explain why the effect of an altering influence may be transmitted to the descendants; in fact they demonstrate that this effect must be transmitted to them. But they do not explain, why the specific disease of the begetter is exactly repeated in the begotten. With those animals who procreate by division, the disease of the new generation is the immediate result of the morbific influences which the old encountered, and therefore must also in its symptoms resemble the disease of the old generation; with those animals who prepare the germ, on the other hand, the germ is originated only under the mediate influence of the morbific influences, to which the parents were exposed; it becomes on that account abnormal, but it does not appear necessary that it should become abnormal in the same manner, or that it must develope the same

abnormal form, which the bodies of the parents attained through the direct effect of the morbific influence. In fact there are diseases which injure the function of procreation, and afterwards manifest themselves in the begotten, as disease or morbid predisposition, without any similarity existing between the disease of the parents, and that of their offspring. The syphilitic dyscrasia of parents occasions in the children perhaps never syphilis, frequently on the contrary scrophulosis, or a so-called general debility, that is, not derived from the defect of any particular organ; the consequences of intemperance, if they appear in the child, will manifest themselves in nervous affections, for instance in hydrocephalus, and other disturbances which are very different from the immediate effects of a long-continued excess upon the part. On the other hand, anomalies suddenly appear in single, and sometimes in several members of one family, of which it is not at all probable, that they owe their origin to any irregularity in the course of pregnancy; anomalies which can be explained by nothing else except a defect of the germ, unless the root of the defect may be demonstrated in the parents or their ancestors.

Kühn has furnished a most remarkable observation of this kind. "A man and woman who were perfectly healthy, and descended from healthy families, had produced five children, which suffered with different abnormalities of the sexual organs and brain. The oldest son, twenty-four years old, was intelligent, three feet two inches high, with weakly-developed genitals, and no sexual passion, and afflicted with cataleptic fits. The second child, a son twenty-one years old, tall, silly, and malicious, but like the former in respect to sexual functions. The third, a girl sixteen years old, three feet high, without signs of puberty, and idiotic; the fourth a girl of ten, and fifth, a boy of seven years, completely idiotic and dumb. The pregnancy was always regular in its course. The increase of abnormality in the younger children is here very remarkable." I have known cases of hermaphrodites and of eunuchs, among several brothers and sisters, whose ancestors and family relations were formed entirely normal.

We may call the disease of the descendants in these and similar cases, *generated* or *begotten ;* and we must distinguish this from the *hereditary* or *inherited* disease, which is not merely a propagation, but also a repetition of the disease of the parents.

The hereditary quality of disease, in the above-discussed meaning of the word, can be derived from no other cause than from the empirically-known nature of the germ, and the semen; the creation from which they originate, the *potentia* to represent itself, and, as soon as the dormant force is aroused, actually (*actu*) to develope itself in a similar creation—similar equally as well in regard to the diseases as to the individual forms, the features, the mental dispositions, &c. The value of this law being recognised, the difficulty lies not so much in comprehending why diseases are hereditary as why they frequently are not. As, therefore, we must establish the quality of being hereditary as the rule, and as a fact not farther explicable, we must examine the conditions which, in particular cases, may oppose the propagation or transmission of ancestral peculiarities.

A limitation of the hereditary quality lies, first, already in the co-operation of the male and female seminal fluids, in the formation of the germ. That both have a share in the product, may be readily determined by observing the mingling of the lineaments of countenance and character, of both father and mother, in the children. It could be assumed with certainty, that, with the other peculiarities, the diseases also and structural defects are inherited from both sides, even if the observations which are adduced in proof thereof were less certain and less numerous. But the product, in the formation of each one part, can follow only the one or the other of the parents. So far as it imitates the father, it must cease to resemble the mother, and *vice versa*. And so by the preponderance of one side, the influence of the other may be destroyed, and a morbid predisposition, as well as the disposition to deposit pigment upon the skin, may be lessened and obliterated. The crossing of a breed is actually recognised as a means of preventing the degeneration of a race, whilst by marriages among relations, certain family traits and family evils are perfected to extremes. Numerous statistics

prove that the development of Cretinism is particularly promoted by intermarriages among relations, and is restricted by marriages with foreigners.

A multitude of questions are connected with these observations, the answering of which would be of the highest practical interest. Which sex prevails in procreation? Upon what circumstance depends the fact, that in one case the father, in another the mother, exercises a preponderating influence? Is the predisposition communicated from father and mother more easily to the sons or daughters; and if this is the case, is it transmitted more readily to children of the same, or of the opposite sex? Are there forms of disease which, rather from the one than the other parent, are transferred rather upon the son than the daughter?

But we have no expectation of seeing these and similar questions very soon satisfactorily decided. All that has been hitherto found regarding these, is merely opinions derived from the limited and accidental experiences of individuals; and a statistic of the hereditary quality is yet to be made out. In the breeding of animals, men proceed very generally upon the supposition, that the young ones in a pre-eminent degree take after the father. In respect to mankind, on the contrary, the opinion prevails that the influence of the mother is the more important. In the procreation of bastards, there are proofs for both opinions (Burdach, p. 519). Assertions, that the father determines the hair, or the organs of motion, or the size of the body—the mother, the nervous system, or the intestines, or the duration of life—are contradicted by quite as many observations as they are supported. Notwithstanding the popular rule seems to be the most frequently corroborated, even with regard to morbid formations, that the son follows the mother, the daughter the father (Burdach, p. 526); still, there are even on this point numerous exceptions.

In this entire department, as in so many allied to it, we have much too often noticed only the quantitative. If we may regard procreation as a battle-ground, on which the paternal and maternal principle strive to separate entirely, or in part, then the consequence cannot depend, at least alone, upon the relative

strength, but it must depend upon the specific form of the predisposition. In a like preponderance of the one or other side, one form of disease must propagate itself easier than another. Determined anomalies must be represented, in procreation, as in other relations, as allied on account of their quality, or as contradictions, and accordingly must increase or neutralize each other; and, in the same manner, it is probable, that through determined combinations in the descendants, anomalies appear, which were formed neither in the paternal nor in the maternal stock.

I must here present one more circumstance, in consequence of which opinions concerning the hereditary quality have at present only a mere provisional worth. There are wanting on the one hand, namely, characteristic signs for the imperceptible beginning of the pathological process, whose distinctly marked forms we distinguish; on the other hand, a more authentic knowledge of the internal affinity of certain forms of disease, whose connexion we certainly conjecture, as, for example, tubercles and scrofula, the gout and hemorrhoids, and others. Thus a body may appear healthy, or only somewhat weakly, which contains already the germ of a specific dyscrasia, and we might consider the diseases of its posterity as new ones, which are actually the diseases of the parents, unessentially modified, but deviating only in their phenomena.

Moreover, the reciprocal limitation of a predisposition in generic procreation, cannot be the only means of rendering ineffective the influence which the one or the other of the procreators has experienced. Among several children of the same parents, there are often only single ones which inherit a disease from the father or mother. If we would explain this fact by saying, that the predominance of the one or the other partner may change in different acts of procreation, then it still remains always incomprehensible how the posterity can remain exempt from an abnormality from which both parents suffered. Burdach relates according to Chemnite a remarkable example: among snails, there are individuals whose shells are spirally turned to the left, and in whom the sexual sac, like all other organs, which usually lie on the right side, is found on the left; they cannot copulate

with the normally constructed individuals, but readily with others which are in like manner spirally turned to the left, and with these they procreate, equally as well, young which are spirally turned to the right. So also there is no doubt, but that docked stallions and mares, and otherwise mutilated pairs of animals or of man, if deformed in like manner, may procreate well-formed young ones, and by way of exception, sometimes internal, usually hereditary diseases of which both parents have suffered, may not be transmitted to the children, or, at least, not to all of them.

We must secondly consider, that the germ is only probably in conformity to the entire animal, that is, that it is regulated by certain extraneous conditions, in order effectually to attain the form which it is destined to represent. As certainly as the normally created germ must degenerate, if it does not meet with relations suitable to its development, so certainly must the abnormal germ degenerate, if the relations under which it grows before and after birth, are not adapted or proportional to its abnormality. Herein is no contradiction to my former assertion, that the germ which conceals within itself a predisposition to morbid development, is already morbid; it had the predisposition to disease, compared with later stages of its development, where disease appears in it by particularly marked symptoms; it is already morbid, compared with other germs of the same age in which the power of healthy development is inherent. I still maintain this decision, and add, that a disease of the germ may be curable, like any other disease, by withdrawing the means which are necessary for the propagation of the pathic process. In this respect I must distinguish three degrees of intensity of hereditary disease or morbid predisposition: the strongest degree is, where the hereditary disease breaks out in due time, in spite of all that may be done to obviate or cure the predisposition, as we must sometimes experience in phthisis, scrofula, insanity, epilepsy, &c; the second degree is, where the predisposition, without additional or new morbific influence, would become disease, but which, by judicious treatment, may be checked in its development; the third and weakest degree is, where the

predisposition, in the individual who is born with it, would, without new morbific influence, remain stationary at the stage of predisposition, and actually needs new, homogeneous morbific influences, in order to become disease.

The adoption of this lowest grade, to which I shall frequently refer, explains how there may be diseases, which we sometimes see appear, hardly otherwise than as the consequence of hereditary predisposition; diseases, which might be first developed in the descendants of a longer or shorter line of ancestors who were exposed to the same altering causes.

If we suppose a noxious potence, which alters the body or an organ, but only exceedingly slowly and gradually, then the change obtained thereby in the course of a human life might escape observation, or at least, would not deserve the name of disease; the descendants of the first generation which had been exposed to such potencies, would resemble their parents, and would therefore carry along with them the effect of the first series of influences, as an hereditary portion in the world, whereto, during their life, the effect of a second series of influences would be added, and transmitted to their offspring, and so on, until the consequence, only in a subsequent generation, would amount to actual disease and be propagated as such; not otherwise, than if the last individual had experienced the whole amount of morbific influences in his own body.

Such is also the case with faculties and talents. Every one knows that the young of expert hunting dogs and horses are trained easier than the young of untrained animals; it is asserted that the young of foxes, which live in inhabited regions, are, from the first moment, more shy and circumspect than those of animals reared in solitude; what the old ones have acquired, is communicated to the young as a specific predisposition, and thereby a higher perfectibility is attained. Somewhat similar seems to take place in the human races. At least without this acceptation, there remains only the adoption of an original diversity of talents, not only among races, but also among nations, and national families, whereby we can explain the greater or

lesser frequency of talents generally, or of certain particular talents in single countries and provinces.

The constant renewal of the species by procreation is certainly the means of curtailing the pathological processes commenced in the progenitors, but only when either the heritage from one side is annihilated by the heritage from the other, or when (as the morbific influences are not at once entirely removed), a new kind of noxious influence originates for the new generation.

Still after all, it remains unintelligible why certain structural defects, for the production of which a previously existing cause suffices—for the preservation and maintenance of which therefore no new morbific influences are necessary, are sometimes transmitted to posterity, sometimes not. We must, therefore, summon to our aid a third ground of explanation, or much rather we must confess, that here is the limit of the explicable, and that in generation as in regeneration, typical peculiarities happen, which we can simply recognise, not explain. It is only single tissues and organs which the living body can reproduce,—the epidermis, the cellular tissue, the bones, the nerves; but not the muscles, cartilages, and glands. It does not regenerate directly the less complicated, or the less important, or those physiologically inferior; and although it certainly proceeds herein according to law, yet it is impossible to find a single expression for the law. It is even so with procreation. Transient anomalies, which are already completely compensated, or nearly so, in the parents, are never transmitted to the children; with regard to others, which leave behind a permanent deformity, we should say, that they are only compensated in the next generation, or at least that they are not in this: in this latter case they are hereditary. The hereditary are not, *par excellence*, as we might expect, the general, deep-seated diseases; the scorbutic, hydropic, icteric quality of the blood is not propagated. On the other hand hare-lip, the deficiency or excess of fingers, strabismus, and such like purely local abnormalities often appear throughout several generations, and among many brothers and sisters. We may establish as a rule of tolerably general application, that inborn defects are more certainly inherited, than such as originated

after birth; notwithstanding that the transmission even of accidentally acquired mutilations is a fact, and it has often happened, viz., that the young of dogs whose tails had been cut off, came into the world without tails.

Hereditary disease may be inborn, or only appear after birth, although its outbreak, or the first appearance of its symptoms, is connected with this or that age of life according to its specific nature. If it is not inborn, then it remains latent, as an *affectio occulta*, until the time comes which is favorable to its irruption.

In order to be correctly understood, I must here ask attention to the double signification which adheres to the word "inborn:" it is used, 1st, in opposition to "acquired," for those properties which belong to an individual from the *germ*, therefore for the hereditary and propagated, and then it must be allowed, that the *inborn* disease can break forth only after birth; 2d, in a purely temporal sense, for those properties which have developed themselves during fœtal life, and are brought into the world with the individual; in this case the *inborn* disease is not necessarily hereditary or generated, but it may be acquired during uterine life by an extraneous accident to the individual. I have comprehended the word in this latter sense, as is evident, when I distinguished hereditary diseases into *inborn*, and those originating after birth, or by way of addition. Most of the hereditary structural defects are at the same time inborn, only because the formation of most of the organs takes place during the period of fœtal life, and *vice versa*, most of the inborn defects are considered hereditary, and generated, because the embryo is supposed to be tolerably secure from exterior, accidental noxious influences. It will be worth the trouble hereafter, in a more appropriate place, to examine whether this is a mistake or not.

A combination of hereditary and acquired disease or predisposition appears when, as I have already stated above, a disease is only prepared by the nature of the germ, and requires for its complete perfection still an addition or increase of morbific influences. If the individual remains protected from these, then the disease maintains itself in him as an *affectio occulta* or *prædisponens*, but as such may be propagated to his descendants,

and in these be developed. It would seem as if disease, leaping over the first, was entailed upon the second generation, *i. e.* from grandfather to grandson. An observation of Heuermann is worthy of remark, where a woman, whose brother and uncle were eunuchs, herself gave birth to eunuchs; thus propagating an evil, by means of an individual in whom it could not possibly be manifested; and thus was transmitted a family disease from the father to the grandson through the daughter who was exempt from it.

An hereditary disease may again become an *affectio occulta*, after the time of its evident existence, when it is either cured artificially, or from its very nature is limited to one period of life. Thus *scrofula* and *phthisis* in the later years of life may subside into the condition of predisposition, and communicate themselves to the germ at a time when the procreators seem entirely free from disease.

CONSTITUTION—HABIT.

By the name morbid predisposition, is denoted each permanent or transient, superficial or deep-seated abnormal condition, in so far as it is considered only as the preparation for some other morbid condition. A particular kind of predisposition, which in every case is continuous, and for the most part inborn or hereditary, and in no case is important enough to be regarded as a disease, is the *constitution.*

The *constitution,* therefore, is only a species of predisposition; it can, equally as well as the predisposition, be itself an abnormality, and again the cause of abnormalities. But that it is something in itself even, is evident from the importance which the custom of language attaches to it. The condition, which under the name of predisposition is considered as something relative in reference to a certain morbid process, appears, under the name constitution, as something absolute, fixed, and spontaneously existing. The word "predisposition" (*anlage*), requires for its exact definition, the interrogation "to what?". To the word "constitution" we supply its exact definition by an adjective. On account of this close affinity, both ideas are easily confounded, and accordingly, if we determine, for instance, a scro-

fulous, arthritic predisposition (contrary to logic, because the predisposition is not scrofulous), then, in such connexions, we use the words predisposition and constitution exactly as synonymous. Therefore it is a ridiculous *idem per idem* to speak of a constitution as something founded on the predisposition: the constitution is much rather the predisposition, and we adopt a particular constitution corresponding to the predisposition only because experience renders it necessary to suppose a special predisposition.

The constitution, as I have stated, is in the rule *inborn*, and in every case is formed by supplementary influences; nevertheless it may also be acquired, or what is the same thing, it may be changed qualitatively by the mode of life, and by diseases which have been endured. If we say of an individual that he has spoiled his constitution, we do not thereby assert that he no more possesses a constitution, but that the *inborn* normal predisposition has become metamorphosed into a specifically pathological one.

That which is called the constitution is, like the predisposition, naturally restricted to the limit between health and disease. With the contrasts of *athletic* and *robust*, of *delicate* and *feeble* constitutions, we denote extremes which still come within the latitude of health; a good constitution is synonymous with a normal predisposition, and is ascribed to a body which has no other than the generic disposition to disease: we pass over idiosyncrasy in the individual constitution, and speak of constitutions which will not bear this or that remedy, and of family physicians and physicians in ordinary who understand the constitutions of their patients. Some kinds of constitution, as of pathological predisposition, correspond to a moderate degree of disease; to such belong the *apoplectic*, *bilious*, *lymphatic*, *venous*, *florid constitutions*, and others. The investigation of their nature cannot be separated from the investigation of the diseases to which they predispose; this must be confessed, even by those who imagine that the innumerable variety of predispositions and corporeal conditions can be referred to the relative preponderance of the one or the other of the so-called normal factors and

systems. As indefinite as may be the ideas connected with the hypothesis of a preponderance of the *lymphatic*, *venous*, or *nervous systems*, nevertheless, in that they maintain an interruption of the equilibrium, they still coincide with the scholastic notion of disease.

To the word constitution is frequently connected, by the humoral theories, the belief in a general peculiarity, reposing in the composition of the blood and humors. Hence the specific constitutions, also, cannot be rigidly separated from the so-called dyscrasia. In general, dyscrasia is nearer to decided disease, and more important than disturbance of function. The disease of the humors from which cancer and tubercle will be developed, is called *carcinomatous* or *tuberculous* dyscrasia. The more obscure and more slight first beginnings of the same degenerations, on the other hand, as well as the insignificant *vitia* of the humors, which may be the cause of hepatic diseases, are called *atrabilious*, *lymphatic*, or *leucophlegmatic*, *bilious constitution*, &c.

That external characteristic mark of the constitution, or of a permanent anomaly, which will be generally considered not quite disease, is habit. The elements which compose it, are the form and color of the external parts of the body, and the maintenance of them, from which may be inferred directly the amount of nutrition, the general and local plethora, the energy of the nervous and muscular systems, &c. Even among the appropriate symptoms of disease, also, a regard for the external parts of the body and their motion occupies an important place; whilst, on the other hand, many actual, even if not exactly troublesome disturbances of function, follow the less distinctly marked pathological conditions. But because, in the critical examination of pathological predispositions, we are referred more to the collective form of the body, in the examination of different diseases, more to the symptoms of single organs, so it has become usual to ascribe to the constitution a habit, to the disease, symptoms.

Certain irregularities in the proportions of individual parts of the body are pre-eminently peculiar to habit: the height of stature in proportion to the strength, the breadth of chest, the length of neck, the size of the head, &c. There are proportions, which

are usually perfected only in a longer time, and during the growth; they cannot therefore appropriately belong among the symptoms of the preceding, at least of acute diseases, but only denote a condition favorable to the *introit* of such diseases.

The empirical physician is perfectly correct, when, in the description of habit, he collects together all the symptoms by which a certain constitution, that is, a proclivity to certain diseases, can be recognised, no matter whether the external signs are causes, or effects of the internal changes which introduce the disease. On the other hand, it is inconsiderate and rash in theoretical compendiums, to regard habit as directly the consequence, or the cause of a morbid condition. If a small chest and tubercles happen simultaneously in the same individual, then it is worth the while to inquire, whether the small capacity of thorax has hindered the development of the lungs, or whether the imperviousness of the lungs has checked the development of the thorax; the latter, at the present time, is considered much more probable. Peradventure there is no *habitus phthisicus*, which was not already a symptom of *phthisis incipiens*, and generally no other constant signs of the *habitus*, than those of the beginning of disease. Whether individual variations entirely consonant with health, like the absolute length of the body, the color of the hair and eyes, and others, are more frequently to be met with in the one or other constitution, is only to be ascertained by way of an earnest, statistical investigation, which of course must precede a general statistical investigation of the proportion of the fair-haired to the dark-haired, of the great to the small, &c.

III. EXTERNAL CAUSES.

As long as the complex of symptoms upon which diagnosis depends, was considered as a unity, and called disease, we were obliged to go back to the internal disturbance causing the symptoms, as to the proximate cause of disease. These, the *causa proxima*, are distinguished from the more remote causes, *causæ remotæ*, the causes of the internal disturbance. Now, as we are obliged to be more profound, as symptoms are no longer con-

sidered as expressions, or manifestations of an ideal unity, but as the effects of a material disturbance, and as the name disease is transferred to the material disturbance, so the idea of disease, and the *causa proxima* coincide; the *causa proxima* of the complex of symptoms (the disease in the sense of the ancients), is the disease itself (in the sense of the moderns).

The *causæ remotæ*, or the causes of disease are plainly distinguished as *absolutely* and *relatively* external. The latter are prepared by the organism itself, externally, but in reference or relation to the diseased part (urinary calculi as the cause of cystitis, pneumonia as the cause of cardiac disease).

The greater, perhaps the greatest, part of the cases of disease, which come under our observation, is the result of a plurality of causes. If several causes combine in one body, a threefold result is possible: the effects of each cause may, 1st, continue entirely or tolerably undisturbed by each other, or 2d, they may promote each other, or 3d, they may restrict each other. To these, by virtue of the peculiar, not always intelligible, relations of the organism which is the subject of attack, is added a fourth, namely, that the effect of a number of morbific influences appears neither as enhancing nor as restricting the effect of each individual one, but as something qualitatively different and not to be compared.

The diseases which proceed from a simple cause, are the *pure* ones; if several morbific causes are combined, the *complicated*, *combined*, *specific*, or *constitutional* diseases are originated. Only when several morbific influences are entirely homogeneous and simultaneous in their effect, so that they blend as it were in one, is the pathological condition corresponding to the same likewise a pure or simple one. Thus, for example, a pure gastritis may originate from overloading the stomach with one, as well as with several different kinds of food; so is intoxication a pure condition: it may proceed from wine alone, or a psychical excitement may have assisted the effect of the wine.

The considerations which regulate our judgment of the purity of diseases in doubtful cases, and by means of which this judgment acquires a practical interest, are principally the two following:—

1. We have been accustomed, in consequence of a necessity immanent to our mind, to classify diseases, without regard to their conditions, after the manner of independent organisms, into species, genera, &c. We thereby abstract from single accidents, and comprehend similar cases in different individuals, as morbid individuals of the same species. As among independent beings we, in this way, form the type of the species, genus, &c. If we now find, that the course of a disease corresponds to *this type*, then we call it *typical*, *regular*, *genuine* or *pure*, in opposite cases *anomalous*, *spurious*, or *false*. An inflammation, for instance, we explain as pure, when it corresponds to the idea or representation delineated according to a great number of similar cases of disease.

But it is evident that this judgment is dependent upon the position or place which the diagnosis assigns to this particular case of disease, and that the same process which to-day we call *anomalous*, may be *regular* to-morrow, if we promote it with the affinities to the type of one particular species. Such metamorphoses have often happened since the existence of medical systems; the bastard intermittent becomes a genuine neuralgia, false croup a laryngismus stridulus, &c. From these examples it is at the same time clear, that the similarity of the homonymous, genuine and bastard disease may be a mere external, accidental, or entirely chimerical one, and accordingly that the one should not be regarded, absolutely and without farther investigation, as the complication of the other. Finally, in that a disease is frequently repeated in the same form, there exists indeed a probability, but no guarantee, that its cause may be single and simple; there happen inflammations and exanthems, which in their symptoms are hardly distinguished from the pure forms, and are only demonstrated as constitutional, by their originating without perceptible occasion.

This leads us to the second criterion, which is to be taken from the ætiological relations of each particular case. By way of experience we have obtained an estimate of the middle worth of each morbific influence, and know the kind and extent of the pathological change which is usually its conse-

quence. In this respect we consider those diseases *pure*, which correspond to the recognised cause, and those complicated which are too extensive for the known cause, or which differ from the ordinary effect of this cause, in their symptoms and course, and thereby disclose a previously treasured, perhaps hitherto concealed mass of anomalies. Now the more considerable this mass, so much more inconsiderable might be the proximate cause; in fact it may escape observation entirely, and we then consider the disease as originating from internal causes, which are nothing else than former causes, whose effect has already become, as it were, a property of the diseased body. Only because experience has taught us that every stab or blow does not necessarily produce schirrus, do we, even in the case where this disease follows such a morbific influence, presuppose other complicating causes, and consider the cancer as a specific or constitutional affection. Because we know that a suppurating wound will heal by cicatrization, we imagine complications if a wound will not heal.

In the next place, then, I must discuss more in detail those diseases which originate from compound causes, and thereby define, more particularly in comparison with each other, the alleged synonymes which may be useful in the explanation of those causes.

The simplest case is, where the causes evidently and for a certain time affect the organ,—where the reaction corresponds to the causes, and the disease is only called irregular because we measure it by an arbitrarily established type. Here belong the so-called complicated wounds and fractures, the inflammations and ulcerations which are kept up by an external mechanical or chemical morbific influence. To such, the name *impure* is for the most part applicable.

I have stated, that the effects of a number of different morbific influences may exist together without essentially disturbing each other. It is always one patient which we have before us, and to whom all the symptoms belong; but then we are able to separate the symptoms of each known morbid process from its isolated appearance. Such a combination, if it is worth while to render it conspicuous, is called in a limited sense a *complication*.

But it is rendered conspicuous, if either the one process is of peculiar influence upon the course of the other, or if the one deserves consideration in the treatment of the other. In this way most frequently, pure local diseases happen in proximity to each other: a chronic disease, local or general, is not unfrequently complicated by the advent of a new acute one; so also several acute, and so-called general morbid processes, as, for instance, measles and small-pox, variola and scarlatina, sometimes meet in the same organism. If the course of one disease is interrupted by the other, or delayed, then the latter is called intercurrent.

A morbid process, in which the symptoms of several happen to be mixed and partly modified, is called *combined*. The adoption of such a combination is justified as well from our theoretical stand-point as by experience. If the effects of specific morbific influences, although different, develope themselves in the same organ or system, if they manifest themselves by certain abnormal formations, why should not these formations unite in themselves the appropriate product of each morbific influence, or vacillate between them? Experience demonstrates to us such mixed products from the effects of the syphilitic poison and of mercury, of the syphilitic poison and the scrofulous predisposition, and others. But medical mythology wanders nowhere so much in the bounds of absurdity, as where, from the reciprocal permeation and cancelling of two morbid organisms, she makes a third, which reminds us of the double tail of the two lions which devoured each other. Instead of examining the condition, on account of which an unusual symptom is associated with a complex of symptoms, this last symptom is taken for the remnant of a partly disappeared complex, to which it belongs according to the rule. If we have icterus, which is accompanied by gastric fever, explained, by a slight attack of bilious fever, the pain of the temples in ophthalmia as "somewhat rheumatic," the red border around an ulcer as a syphilitic combination, then must we admire the sufficiency of human intellect.

A disease is called *constitutional*, when, in the morbid process produced by a concurrence of causes, the symptoms of those processes which belong to the individual causes can no longer

be distinguished. Constitutional disease arises by a series of morbific influences, whose individual effect is not perceived, or at least is of no account, and yet its admission into the system is veritable disease ; it originates from influences of so slight intensity, that although they leave behind changes, those changes are less perceptible, in a measure compensable, and not presentable to the physician. It has its own peculiar symptoms, which are not to be imitated in the healthy by any of the usual irritants, because it is gradually brought about by the repeated effect or operation of a morbific influence upon an already changed matter, endowed with anomalous forces and reactions. It is in this way that the symptoms of acute diseases change, even while the occasioning morbific influence continues to operate. The first effect of the introduction of a foreign substance is congestion and inflammation ; if the foreign substance remains, it continues to irritate, not a healthy, but an inflamed organ : therefore, *pure* inflammation cannot continue with its own typical symptoms or renew itself, but it developes an idiopathic disease, an ulcer, a parasitic tumor, proud flesh, &c. The consequence of a violent pressure is inflammation ; the consequence of a moderate, continuous, or frequently repeated pressure is hypertrophy, degeneration, perhaps cancer.

As these diseases arise slowly, so do they admit the distinction of a predisposition or constitution, that is, of a morbid condition to which still something is wanting to make it complete and entire disease. The morbific potencies, happening at different periods, may be distinguished according to the time of their effects. And hereupon rests the division of external morbific influences into predisposing (*causæ predisponentes*) and procatarctic, or exciting causes (*causæ occasionales*). They are called predisposing, as long as their effect is not considered disease ; that event which finally occasions the outbreak of the disease, is called the procatarctic cause.

These ideas are quite as relative as those of predisposition and disease ; the predisposing corresponds to the predisposition, the exciting cause to the disease. As far as we consider a disease as a predisposition, so far are the external causes of the dis-

ease predisposing; thus, for example, the exciting causes of scrofulosis are predisposing, in respect to a scrofulous inflammation, which arises when an ordinary inflammatory irritant operates upon scrofulous persons. In the rule, we put the effect in place of the predisposing causes, as in the case mentioned, the *scrophulosis* in place of the external agents which produced it. But in fact, the scrofulous inflammation is not the result of *scrophulosis*, and of the exciting causes, but the consequence of the exciting causes of *scrophulosis*, and at last of the exciting cause of the inflammation.

One and the same morbific influence, long and slowly operating, may occasion at first an evident or concealed predisposition, and at last become an exciting cause, as in a gradually accumulated weight, a grain at last turns the scale. I have already mentioned before, that a noxious potency, in this way, can be extended over a whole generation, or, in other words, that the predisposing causes of certain diseases must be sought in the lives of the preceding generation.

Pure diseases correspond to one cause, which is the exciting cause; in constitutional diseases, as is well known, the exciting cause may be imperceptibly small, in fact it is actually superfluous if the outbreak of a disease depends only on the entrance of the organism into a certain stage of development. Moreover, the predisposing causes are probably more frequent, and the exciting causes more seldom, than is commonly supposed. We too willingly rest satisfied with any one event, catching cold, an excess, &c., without always reflecting, how often perhaps the same individual has been exposed to similar and even greater morbific influences without detriment.

In another sense many influences may be called predisposing, which only tend to render the body qualified for the reception of certain morbific influences, without the effect of the predisposing causes themselves appearing in the diseased body, or being of any particular influence upon the morbid structure. Thus are, perhaps, depressing affections, errors in diet, &c., to be regarded, in relation to prevailing epidemic diseases; thus the organism,

by an abrasion of the skin, becomes predisposed to the syphilitic or vaccine virus, because these contagiums do not readily penetrate the unabraded cutis; and in the same manner, certain positions of the limbs, which are more favorable than others to dislocation from mechanical force, are reckoned among the predisposing causes of luxations. Here the predisposing and exciting causes may happen at the same moment of time; the same instrument which infects has also made the wound.

We have stated, that the effect of one morbific influence may be directly destroyed by another. Hereupon alone depends the art of the physician. Two poisons may neutralize each other in such way, that the one annihilates the effects of the other; a hemorrhage, which would make the healthy *ancæmic*, might restore to health one affected with an inflammatory disease. What the physician does intentionally even, sometimes accomplishes an event more favorable to the patient than he expected, an event which he should make available as an indication in future. Diseases whose causes are opposed to each other, cannot happen simultaneously in the same body; *vice versa*, we may consider, that the morbid processes which never or seldom undergo a complication, develope themselves from relations or conditions opposed to each other, or at least not readily combining. If we separate, for instance, pneumatosis and phthisis from each other, then the cause of emphysema must oppose the formation of tubercles. One of the causes of emphysema is violently strained respiration; accordingly, it was supposed, and with reason, that the predisposition to tubercles, or the beginning of tuberculous phthisis, could be opposed successfully by violent respiratory motions.

III.

DISEASE IN ITS RELATIONS OF EXTENT.

I. THE SYMPTOMS OF DISEASE.

The healthy condition of the body and of the individual organs is perceptible to the senses by the external figure, by the form and composition of the parts, and by the function of the same.

The morbid condition betrays itself by deviations of the external appearance and of the functions from the normal standard. Changes of the aggregate condition and of function, whereby disease becomes sensibly perceptible to the patient himself, or to others, are called *symptoms* or *phenomena* of disease.

According to the strict idea of the word, *symptom* is therefore the external, sensibly perceptible appearance of disease, no matter whether it be changed function, or a change of the aggregate condition. Disease, on the contrary, is the logically ascertained, not sensibly perceptible, but supposed cause, of the morbid appearance. For this reason, therefore, the symptom is the conditioned, disease the conditioning; and to the symptom as to the disease belong two attributes: the symptom is the external and the effect, disease is the internal and the cause. Inasmuch as both ideas are now considered, at one time under one attribute, at another under the other, they have at the same time become amplified, and have lost their precision. If a symptom signifies only an external sign of a disease, then it is indeed always in the relation of cause to this disease, although not mentioned in direct causal relation. It is said of the gastric headache, that it is a symptom of affection of the stomach. But headache is not the most immediate nor the necessary consequence

of gastric affection alone, but of any other changes of the nerves of the forehead, and therefore, strictly speaking, is only and exclusively a symptom of affection of these nerves, which in turn may be one result of gastric disease.

If, on the contrary, a symptom is considered as a consequence, as something conditioned, then it is not necessarily an external sign, but may even be again the cause of others, in the strict sense, perceptible symptoms. Dropsy, for example, is in itself not capable of being known to the senses, but it is inferred from the form and the resistance of the tumor, from the conduct of the aqueous secretions, &c. But as dropsy is occasioned by certain diseases of the blood, by a tumor which compresses the veins, &c., it may be regarded as a symptom of this latter disease; again, the tumor may be called symptomatic in reference to another general disease, &c. Hence it is, that in this sense no definite boundary exists between disease and symptom generally. In the complex organism all changes are in continual succession of causes and effect; all are at the same time occasioned, and occasioning, and it is our own opinion which arbitrarily places here and there the limit, from which it beholds on the one side the cause, on the other side the effect.

The imperfection of our knowledge with regard to the nature of the morbid process, is partly owing to a want of perspicuity in the technical expression, which is the more injurious, because it conceals the defects of science. Icterus arises, no matter how, from evident disease of the stomach, brain, and other organs. But it also happens spontaneously, without other simultaneous affections. In the first case it is called symptomatic,—a symptom of a demonstrable disease, as the consequence of which it appears; in the second case it is called an *idiopathic* disease. But the symptomatic icterus is not a symptom of disease of the stomach, brain, &c., but of a changed condition of the liver; and the *idiopathic* icterus is not the disease, but again only a symptom of some one changed condition of the liver. The difference amounts to this,—that the affection, in the one case the consequence of another disease, is, in the other case, excited as it were by a direct morbific influence.

A morbid condition occasioned by another disease, which is not directly perceptible to the senses, is well called *symptomatic*, in opposition to *idiopathic* disease; and we denote thereby a middle point between disease and symptom.

Symptoms are either such as the patient only is conscious of, or such as are accessible to the perceptions of the physician. Hereupon is founded the division of them into *subjective* and *objective*. They denote a state of repose or of excitement, and hence are called *passive* or *active;* and it should be here mentioned preliminarily, that the decision whether a symptom is active or passive, is not a matter of course, but is sometimes arrived at only by toilsome investigation. Symptoms are essential (*necessaria, essentialia*), or accidental (*accidentalia*), according to the greater or lesser degree of constancy with which they appear in known complexes, or in certain pathological processes. The most constant signs are called *characteristic* or *pathognomonic*. Those phenomena which are occasioned in the patient by adjacent circumstances, not connected with the disease or the morbid cause, are also called accidental. Those symptoms which make themselves known to the suffering organ, are *primary* or *direct;* those which are perceived in other parts, are *secondary* or *indirect*. I shall presently allude to the distinction of symptoms into *local* and *general*. Finally, we must mention, in opposition to the symptoms of disease, the *symptomata causa*, as those from which particularly a conclusion is to be derived concerning the morbid cause. The powder burnt into the flesh after gun-shot wounds, the alcoholic smell of the breath after poisoning by spirituous liquors, &c., are symptoms of the cause.

II. LOCAL AND GENERAL DISEASES.

Symptoms of the aggregate condition, as well as of function, may be local or general.

The symptoms of the aggregate condition are called *local*, when they are referred to a limited portion of a tissue, or to a particular organ; *general*, when they include the whole extent of

a tissue,—for example, of the skin, of the muco-membranous, or osseous systems, either simultaneously or by degrees.

Functional disturbances are *local* symptoms, when they refer to a determined organ, or to a limited portion of the body; *general*, when they cannot be referred to an affection of a single structure, either by our physiological principles or by the sensations of the patient. Symptoms of this kind are, for instance, defects of nourishment, changes in the susceptibility to impressions of heat and cold, and in the vital energy or strength.

If we argue from the symptoms as the effect, upon the disease as the hidden, not sensibly perceptible cause, then we may suppose, that the disease which causes a local symptom, is itself likewise locally limited, and the disease causing general symptoms is of a more general nature. Therefore diseases likewise become primarily distinguished into local and general. If we compare certain extremes, for instance, the condition of one affected with hernia or hydrocele, with the condition of a fever patient, then we find ourselves actually urged to the recognition of such a principle of division. But the question is, whether an exact boundary can be drawn between both groups, and if this obtains, what signification and what value has the classification.

Were symptom and disease always embraced in the above laid down exact sense of effect and of cause, then there could be no doubt, that the extent of the symptom should correspond to the extent of the disease. A disease of the heart changes the pulse in all parts of the body, a disease of the medulla spinalis the action of all the nerves ; but strictly considered, the pulse, pain, and spasm are applied only to the condition of the arteries and nerves ; if we presume from this to judge of the condition of the central organ of the vascular and nervous systems, then it is done by passing over a number of intermediate steps, which is not in all cases to be justified. For this reason then, because we do not consider strictly the relation of the symptom to the disease, and because the causal connexion is not always a direct one, and a long series of intermediate links may lie between the two terminal links, the question might be started, whether a local symptom may belong to a general disease, or a general

symptom to a local disease, or whether there are any such things as pure local and general diseases. It should not and could not be denied, that in one case a wart may happen, scarcely noticed by the collective organism, in another a general prostration with anomaly of all the secretions, and with a changed appearance of all accessible parts, and the fact remains, and the empirical distinction remains undisputed for all ages; but the thinking physician would reflect, that that wart must be the consequence, or to use a higher term, the reflex of a general malady, and this fever nothing else than the expression of a local disease.

But how could an agreement upon the generality or locality of a morbid process have been possible, before it was known what was comprehended under the name! The school had declared disease to be the *causa proxima* of the symptoms; it was translated the *final cause*, and they began to reckon from the symptoms of disease. Now the theorist transported his doctrine of the nature of disease, like a cat its young, from one story to another; where a process of reasoning *à posteriori* had ascertained a cause of the previous cause, he adopted it, and called all on this side of the previous position of the doctrine of the nature of disease "*symptom*," and all that side "*cause*." Thus fever was first general, because a disease of the mass of blood; when it was discovered that the deficiency in the composition of the blood may proceed from local congestion, fever became localized; when the result of a vitiated state of the blood was perceived in local congestion, this disease became again generalized. By this means the true *causa proxima* of fever was not at all considered. If it had been remembered that fever symptoms are caused by an alteration of all or many nerves, then it would have been called pre-eminently a general disease; if, after that, the cause of this change of the nerves had been discovered in a part of the central organs, then it would have been again stamped as a local disease.

At present we know that disease is a process composed of different local, partly general changes, of changes whose causal relations to each other may be extremely various. Before we assign to a disease its place under local or general, we must

be agreed as to what link of the chain of conditions shall be considered as essential, and above all in what kind of connexion the different links stand to each other in individual cases. As long as this remains a disputed point, every decision in regard to it must be suspended.

When we shall have despatched all that pertains to the mythological treatment of disease, when we shall have completely renounced all faith in the *entia morbi*, which at one time were thought to invade all mankind, at another only a particularly small portion of them, then it remains only to inquire under what circumstances external morbific potencies develope their influence in single structures of the body, either in many or all; and it will be demonstrated, that an answer cannot be given without regard to the nature of the morbific influences, and to the internal arrangement of the body.

It is a self-evident fact, that the extent of disease is regulated by the sphere of operation of the cause. Mechanical injuries, for the most part, produce local diseases; whereas all the molecules of the body are equally attacked by changes of temperature, of the pressure of air, by electric currents, &c.

But, from locally-applied morbific influences, general diseases also may arise, where the injured structure, by virtue of its physiological dignity, is necessarily followed by changes of many or all the organs. Such structures, above all others, are the central organ of the nervous system and the blood. The same splinter, which in the finger excites a circumscribed inflammation, if driven into the brain, occasions the most extensive pains and spasms. The same poison, which, locally applied, draws a blister or acts as an escharotic, when it is absorbed in the blood, occasions effusion in a number of organs, and disordered function in almost every part of the body. The only cause for this is, the peculiar arrangement by which the nerves of all the organs lie together in a narrow space in the brain, and by which the blood is driven into all parts of the body.

But diseases of the blood are still in another sense *general*, like the diseases of the central organ of the nervous system and of the solid parts generally. In the solid tissues, namely, each

fibre, each cell, is an independent part. If they suffer in common, it is caused by particular circumstances; every drop of the blood is distributed to the whole; in whatever division of the vascular system it becomes changed, the deficiency in composition, or the *admixture*, is communicated to the entire mass. All the nerves may be put in requisition by the central organ, although this does not always happen; but the sympathy is limited to single groups, according to the form and the seat of the disease. In defects of the blood, each particle must, under all circumstances, participate; there is no partial disease of the fluids.

We might, therefore, consider diseases of the blood as the necessarily and absolutely general, in opposition to diseases of the solid parts, which are really local and only more or less extended. But for the reasons already adduced, this distinction is but of little value; only a few diseases are permanently limited to the fluids or to the solids alone. In the rule, the disease of the one is very soon necessarily followed by disease of the other.

Where there is an abnormal condition of the blood, the nourishment of the solid parts suffers exactly in proportion to its physiological relation to the individual ingredients of the blood. Among the pathological conditions of the latter, only one is known which does not appear to injure the other tissues; I mean that dyscrasy of the blood, whose existence is often unknown until after an injury of the vessel, when the inability of the blood to coagulate is perceived. For all other dyscrasias, the symptoms furnish us directly with the solid tissues secondarily attacked. Even the evident poisonings of the blood, for instance, by lead, ardent spirits, by certain contagions, are diagnosed almost entirely from the disturbances which the nerves experience from contact with the poisonous blood.

The quality of the blood is changed by abnormal activity, or by inactivity of the organs. Each organ, besides its external effects, is of service to the whole, by withdrawing certain ingredients from the blood, and by communicating others to it; so that the fluids, mixed and returned from all the vessels, represent again the blood in its integrity. Each deficiency or excess, in

any one vessel, reflects back upon the whole. This reflex action may be a little evanescent; but it is so much the more apparent, the more characteristic and considerable the chemical action of the organ is. Each moderately-extended inflammation changes the entire mass of the blood; but the inflammation, with the functional disturbance connected with it, is of course of double importance in the organs, as the lungs, liver, kidneys, &c., in which the purification of the blood is carried on by certain excretions.

Because the diseases of the humors usually attack several organs, and that tissue, in its whole extent, to which they have particular reference, we have gradually, but erroneously, become accustomed, without farther investigation, to behold in every widely-extended symptom, the manifestation of a general disease in the theoretic sense of the word; that is, of a *humor* disease. Our humoral pathological zealots have neglected to observe, that separate local phenomena may have their foundation in a change of the mass of humors. They have frequently pursued even the germs of warts, corns, moles, cystic tumors, chancres, and others, much farther in the blood, than could have been possible for an unprejudiced observation of nature; and, by their caution against inconsiderate external attacks upon these excrescences, protected by the blood and necessary to the blood, have furnished an estimable contribution to the chapter of German prescience. On the other hand, they have not even inquired whether general symptoms can be derived in any other way than through the blood; and they rise up in arms, like an old woman, at every attempt to deprive the blood of this privilege. Hence it is perhaps useful, once more, particularly to mention the double sense which lies in the word general disease, to separate the *empirically* general disease, that is, the proximate organic cause of general symptoms, from the *theoretically* general, or blood disease, and *vice versa;* although we are necessarily reminded by the foregoing, that empirically general diseases also arise through the intervention of the nervous system, and by the directly-diffused effect of the external cause. A burn is general, if the hot medium comes in contact with a large part of the sur-

face of the body. An eruption may become general, if the inflammatory potency spreads extensively over the skin. Of these effects, the blood may be entirely innocent.

General disease, or disease from general causes, is frequently used in the same sense as constitutional disease; in a case which seems to have arisen without sufficient exciting cause, we suppose a *constitutional* or *general* predisposition. This confounding one thing with another may be justifiable perhaps in most cases; most constitutional diseases are not only in an empirical, but probably also in a theoretical sense *general*, because they make their irruption not only in many places of the body, and in the entire extent of one tissue, but also seem to owe their first origin to such causes as operate upon and through the humors. Nevertheless it is always imprudent, and not without prejudicial influence upon the treatment of individual pathological processes, to consider constitutional and humor diseases as exactly synonymous. It will readily be acknowledged, that not every disease of the humors is constitutional. So also not every constitutional disease is a disease of the humors: mania and rheumatism may be constitutional; but I know not one proof that they are caused by a defective condition of the blood.

That disease is constitutional, which arises by a long series of inconsiderable influences without remarkable, or at least without adequate exciting cause: the diseases of the blood are general, without regard to their origin. I would call the *syphilitic* dyscrasy, general *syphilis*, not constitutional; I would say of hereditary mental disease, that it may arise from internal or constitutional, not from general causes. Other diseases, as gout, scrofula, and others, are at the same time constitutional and general.

III. SYMPATHY AND ANTAGONISM.

It lies in the very idea of the organism, as of one entire whole, composed of members which are effective in the maintenance of the whole, and it is evident from the reasons adduced, that each part stands in reciprocal relation with all the others.

Each part is preserved in a healthy condition, only while all the others discharge their functions in their integrity, and an irritation of each single part operates reflectively upon all the others.

If this relation of all parts to each other were a general and uniform one, then the result of a change of one part must communicate itself equally to all others, and distribute itself to all the others.

But we find every instant, as well in physiological as in pathological processes, proof of a particular co-operation of certain particular organs, so that the changed condition of the one expresses itself by the changed condition of the other, and excitement of the one, occasions excitement or diminished activity in the other. Strong light, that is, violent irritation of the retina, produces contraction of the pupil; of the eyelids, sternutation, &c.; a loud sound causes starting of the body; the irritant of food, secretion of saliva; of snuff, discharge of tears; touching the glottis, cough, &c.: in the same manner, in pathological cases, headache is produced by indigestion, spasm of the bladder or catarrh, by rapid cooling of the skin, spasm in remote muscles by toothache, pain in the shoulder by liver disease.

Two organs, which are thus excitable and changeable, the one by the other, stand, as we say, in *sympathy* or *consensus*, using the word in its widest signification.

Two different cases are possible, in which the consensus of two organs is perceptible:

1st. The change of the one occasions a homogeneous change of the other; increased excitement of A occasions increased excitement of B; paralysis of A, paralysis of B; inflammation in the one part, inflammation of the other. This is *sympathy* or *consensus* in a narrow sense; where it requires an exact designation, I shall use for it the word *synergy;* the change of the second organ is called *sympathetic*, *consensual*, or *synergetic*.

2d. The change of the first organ occasions the opposite in the second; the excitement of A depresses the excitement of B; diminishing the excitement of A increases the excitement of B; congestion in the one part cancels the congestion in the other.

These are the phenomena of antagonism; this change of the second organ is called *antagonistic.*

Synergy and antagonism are both effects of a peculiar connexion in which the irritated parts stand; it depends upon particular circumstances, which are unfortunately disclosed only in a very few cases, whether the sympathy is expressed in the form of synergy or of antagonism. In general, it may be remarked, that the connexion between two organs is either exclusively synergetic, or exclusively antagonistic, or it is alternate, now as synergetic, now as antagonistic, and perhaps only more frequently appears in the one or the other manner. Certain parts of the nervous system are so connected, that by excitement of the one, the excitement of the other is always increased, as for instance, the consequence of irritation of many nerves of sensation is always reflected motion, and never relaxation of the corresponding muscles; the sympathy between the skin and kidneys, on the contrary, is always antagonistic, and between single regions of the membranes, and between many sensory and motor nerves, the relation may be synergetic or antagonistic; thus inflammation of the mucous membrane of the nose (catarrh), may continue as an exanthem upon the external parts of the nose and the lips synergetically, and is cured, antagonistically, by cutaneous irritants; tickling of the lower extremities occasions spasms; spasm of the tibial muscles disappears upon rubbing the skin in the tibial region, or by pressing the sole of the foot against a solid body.

If two organs stand in a relation, which is manifested as well by synergy as by antagonism, then a complication of both contrasts is possible, in such way, that A increases the excitement of B, and in return the increased activity of B reflectively depresses A. A not only shares its condition with B, but transfers it also upon B. Therefore this relation may be called metastasis. If this takes place several times, then it is called alternation. Metastasis and alternation are not unfrequent in the department of nervous sympathy, and I shall hereafter introduce a number of authentic proofs of this. Sometimes the excitement of A, which, according to typical laws, or according to the introductory course of a disease, would be expected, discontinues entirely, and

in its stead an excitement in B appears. Here the activity of B is vicarious. In many nervous diseases, which consist of single attacks, the vicarious and the transferred excitement are not easily distinguished; but truly vicarious is, for example, the congestion or hemorrhage, which, instead of the menstrual congestion and hemorrhage, and in deficient turgescence of the sexual organs, appears in other parts of the body, in the Schneiderian membrane, the lungs, the stomach, &c.

An organ that is actually capable of becoming vicarious must, as it were voluntarily, or impelled by external circumstances, appear in the place of the one originally designed, and play its part.

The phenomena of sympathy, as well of synergy as of antagonism, depend upon a physiological cause, upon the original, legitimate combination of single organs and structures. Only those communications are consensual which are introduced and effected by a permanent and typical relation of the parts to each other. Ulceration of the lungs, for instance, in the glanders, may accidentally produce secondary abscesses now in this, now in that division of the vascular system belonging to the systemic circulation; but we should not infer from this any sympathy between the lungs and the part in which the metastatic abscess has its seat. Nevertheless, *normal* and *abnormal* sympathies may be distinguished; the normal belong to every healthy body, in fact they are to the part like contraction of the pupils upon irritation of the optic nerve, conditions, without which the normal function could not be perfected. The *abnormal* sympathies are unusual, either from the facility with which, or the extent to which they occur, or also from the fact that they take place between parts usually not sympathizing.

Sympathies determine the extent of disease and its form, of course according to the part on which the morbific potency has exerted its influence. A special knowledge of them is indispensable to the physician, partly in aid to diagnosis, because many diseases of internal organs have for symptoms only the results of sympathetic irritation in accessible structures, partly in aid to therapeutics, because many organs can be affected only

through those sympathetically connected with them: the derivative method of cure is founded upon the law of antagonism.

There are two principles of division for classifying the multitude of individual sympathies:

First, we may proceed from the organs, tissues, and symptoms, and enumerate the sympathies peculiar to each one; and, second, we may classify the ways by which sympathies are effected. Neither of the two methods is capable of exhausting the variety of possible combinations. The first must properly lead the way to the second; however, it leads into many by-paths without the criticisms which the second suggests. I choose therefore the latter, and will endeavor synthetically and summarily to place together the sympathies, according to the sources of sympathy which are inferred from the organization of the body. In order to succeed in this, the idea of sympathy must be defined as rigidly as possible, and the modes of propagation of morbid processes, which are not comprehended under the same, must be excluded.

In order to be called *synergetic*, or *antagonistic*, the change of one organ must be the result of the change of another. Above all we must be certain that the coincidence of the two phenomena, is not a mere accidental one, and then also, that it is not the effect of a cause common to both. No one would imagine a sympathy between the hair of the head, and the beard, because both are singed by the same flame; there is equally as little proof of the *consensus* of organs, when the same internal morbific cause simultaneously attacks them. Organs which sympathize with each other, readily become diseased with each other; but all organs, which become diseased simultaneously, are not sympathetically connected. An affinity of an entirely different kind, the similarity of structure and of function, furnishes the same result. It is not sympathy, but this anatomical relation of affinity that is the cause of the different serous membranes, the joints, bones, and other parts suffering with each other, when the blood supplying them contains an abnormal quality. In the same category belong most of the so-called sympathies of tissues, as they have been treated in the manuals of physiology and pathology, according to Bichat's process.

Several parts may suffer in common, when the morbific cause itself, for instance, contagion, is internally conducted from one to the other. Here also the affection of the secondarily attacked organ is not sympathetic, because it is not the consequence of the disease of the primarily affected organ, but the effect of the cause which was taken up in the body by the primarily diseased part.

But not every process is sympathetic, which even in sequence and occasioned by another, appears in another place. Plethora of the gall-bladder is the result of the deficient growth of its excretories, and yet I do not imagine that any one would ever have deduced from this a sympathy between the bladder and the excretories. The fulness of the gall-bladder is here consecutive; but it were ridiculous to call it sympathetic. Just as little would any one see an example of *consensus* in the contraction of a muscle by irritation of its nerves, or in the dilatation of an artery by the impulse of the heart: we are satisfied to acknowledge the one as the effect of the other. The customary usage of language is so decisive in this respect, that it is difficult to define exactly the kind of effects which are regarded as the expression of sympathy; because the idea of sympathy is one of the many originally popular ideas, whose scientific meaning has been subjected to many changes in the course of ages. The phenomena which stand in direct causal and constant connexion, never are ascribed to sympathy; the connexion must ensue without the appearance of necessity, as a voluntary and unexpected sympathy, and it does so ensue, even if it requires some one intervening agent, which may be sometimes present, sometimes wanting. Accordingly, the sympathetic affection would be a species of the consecutive, in that by the consecutive every causal connexion is indicated, by the sympathetic only the *direct* causal connexion is indicated. It is well understood that even the relation of indirect effects to each other must have its limits; even the last link of a long chain of causes is consecutive in relation to the first cause, without being sympathetic. The formula which might be laid down as the tolerably general authentic expression for the process of sympathy, is: A operates upon B through the medium of X.

That interposed medium is the source, or conductor of sympathy.

I have already remarked above, that the very idea of *consensus* includes the representation of a permanent connexion, and one indissolubly fixed by the original organization. Therefore we recognise, as the conductors of sympathy, no other structures than those which are permanent, and included in the original plan of organization. Accidental external substances, or those new and transiently produced by a pathological process, cannot be conductors of sympathy, although they are sometimes the means whereby one organ involves a second in the morbid process. That by the precipitation and migration of such products as stones, pus, abnormal acrid secretions, and others, disease is produced, is nothing sympathetic; and the irritation of one organ by the morbid product of another; is no proof of a *consensus* between the two.

Sympathy, in the popular sense of the word, is reciprocal: whichever of two sympathetically-connected parts shall be first attacked, calculates upon the concurrence or participation in suffering, of the other. This does not prevent one part from being, by its situation or function, pre-eminently or exclusively exposed to external impressions; and therefore, in certain cases, it may demand sympathy, not furnish it. Organic sympathies also are, fundamentally, reciprocal; the conductors from both sides seem to accommodate both sides with equal readiness.

But the relation of the organs to the conductor, their facility of being influenced by the same, or of being determined by it, may be different; and by this means the sympathy acquires the appearance of one-sidedness. I shall have to discuss this question more at length among the nervous sympathies.

According to all this, sympathy (in the broadest sense) or *consensus* may, in conclusion, be defined as the *inborn, or habitual connexion of the parts of an organism, interposed by one of the normal tissues or organs, in such a manner that, reciprocally in the rule, the changed condition of the one causes a change in the other.*

This definition seems to me in general sufficient to distinguish

sympathetic reactions from the direct, simply consecutive reactions, and from those which originate from transmitted causes, or from accidental morbid products. According to this, will be readily intelligible, for instance, what is meant by the question, whether plethora of the vessels, from cutaneous irritants, is direct or sympathetic. It could not be expected, however, that this distinction should be rigid and decisive for all cases, as even normality and abnormality are not exact antipodes, and as the number of intermediate members, which will be considered among the indirect effects, often depends upon more subjective observation, or upon the accidental condition of knowledge. It is established neither arbitrarily nor by reflection, whether the participation of the lymphatic glands, in the diseases of the organs whose lymphatic ducts they receive, should be called sympathetic or simply consecutive. Finally, this difficulty is of slight amount, and will vanish entirely, if we dispense with the general idea of sympathy, and learn to denote each specific act of translation of disease with the words characterizing the particular event.

We recognise two tissues as conductors of sympathies—the blood and the nervous system; and, accordingly, we form two classes, sympathies through the blood, and nervous sympathies. Thereto we must add a third class, consisting of sympathies whose source is unknown; of which, at least, it is not certain whether they are interposed by the blood or the nerves.

A. NORMAL SYMPATHIES.

I. SYMPATHIES THROUGH THE BLOOD.

By the intervention of the blood, those parts stand in *consensus*, which have the same relation to one of the ingredients of the blood.

This relation is manifested by the attraction of the ingredients of the blood in support of nutrition, or of secretion and excretion.

If the secretion of a substance from the blood is carried on by several organs, then these participate, to a certain extent, in the substance to be secreted, according to a typically regulated proportion. The quantity of this substance may be augmented from any external causes whatsoever, so might the activity of all the secreting organs simultaneously increase; the contents of the blood remaining equal in respect to the matters to be secreted, the task for the rest must be augmented by the inactivity of each one of the associated organs, and *vice versa*, after excitement of a single one of the same, the labor for the rest must be diminished.

The sympathy of organs by the blood, therefore manifests itself always in the form of antagonism; one organ takes upon itself entirely alone the part of the associated organs, hence its function seems vicarious.

In the latter instance, perhaps each antagonism, also in the nervous system each general exhaustion in consequence of partial exertions, may be referred to the above-described process. But a remarkable reciprocal action between special organs belongs to the idea of sympathy. Such an one generally takes place between the organs of secretion, and even here in much more limited measure than we are usually accustomed to consider.

A faculty of separating specific matters from the blood, or of preparing the specific secretions, universally appears to be connected only with one gland, or to a number having the same name, for the most part to a pair of glands; without doubt, both kidneys, testicles, or breasts, stand to each other in the above-mentioned antagonistic connexion; but no observation, with one single exception, authorizes the opinion, that any other one organ of secretion pre-eminently or exclusively can take the place of the liver, or both kidneys, or both mammary glands. The products of secretion retained in the blood, bile, urea, adipose, &c., are much oftener seen, now in this, now in that secretion, sometimes also in all at the same time, and even, like the bile, in the solid tissues of the body. It is therefore erroneous, from the fact that jaundice is developed in liver diseases, to adopt a sympa-

thetic and vicarious relation between the skin and liver, from the appearance of bile in the urine to adopt such a relation between the liver and kidneys; every other organ likewise receives its share of the morbid excretions prepared in the *plasma;* if these, in any case, seem to have a particular predilection for one part, and deposit themselves in it, then, such a part, as the inconstancy of the process teaches, must be already predisposed, that is, abnormally constituted; the process belongs to the pathological sympathies, and among these will be discussed more in detail.

The observation to which I alluded above as the single exception, refers to a sympathy between the liver and the glands which secrete the wax of the ear, mentioned by Eberle. In a patient whose liver was diseased, there appeared a very copious flow from the ear, of a brownish matter, bitter as gall; the suppression of this discharge resulted in jaundice, which again disappeared with the reappearance of the secretion from the ear. The similarity between the secretion of the liver, and that of the glands of the ear, although it is only external, makes this case, isolated as it is, worthy of consideration. Perhaps the tolerably frequent deafness of the right ear happening in diseases of the liver, may be in some such way connected.

In reference to other more indifferent ingredients of the blood, which are repeated in many secretions, an antagonism of the glands concerned is indeed possible, but the cases in which it is demonstrable and essential, reduce themselves almost entirely to the relation between the skin and kidneys. The indifferent products of secretion, as they appear in the secretions of the respiratory, mucous, salivary, and lachrymal glands, of the pancreas, of the prostate, and others, are normal ingredients of the blood, whose relative quantity may vacillate within certain limits, whose loss may be more or less easily compensated by external supplies. A slight increase or diminution of the same, is therefore without perceptible influence upon the mass of blood generally, and upon the associated glands in particular; and, as it is certain that the aqueous portion of the blood is diminished by wine, so it is diffi-

cult to prove empirically such a fact, if the loss of water from one or the other gland is shared by the rest.

This distribution, moreover, is not entirely uniform, but is appropriately regulated by a determined law. Whilst the secretion of water is constantly taking place by the kidneys in the fluid form, by the skin and lungs in the gaseous form, the other glands mentioned furnish considerable quantities of a watery secretion only at times, and under particular circumstances. If the aqueous portion of the blood is augmented by external means—for instance, by a copious drink—then the secretion of urine is increased, and without doubt also the transpiration of the skin and lungs; but there arises no flow of tears or of saliva, and no perspiration, unless at the same time one of the occasions, which may be regarded as an irritant of the skin or mucous membranes concerned, is present. Accordingly I conclude, that the kidneys stand in a particularly active relation to the water of the blood, as is abundantly proved from the attraction of water by the kidneys; but that the exudation from the other glands should be compared to congestive exudation, and directly depends, not upon the quality of the blood, but upon those influences which induce the congestion. The evaporation of water by the skin and lungs occupies an intermediate position: it is governed, on the one hand, directly by the abundance of water in the blood; on the other, by the abundance of blood in the skin, which is again limited by the condition of irritation of the latter. From this results the following consequences:—

If the aqueous evaporation increases under the influence of irritants, or any other considerable watery secretion is induced, then the quantity of water in the urine becomes less, the urine scanty, saturated with all the characters of color and sedimentous formation, which I shall consider more in detail in the symptomatology of the urinary organs.

If the evaporation by the skin and lungs is restricted, on account of the contraction of their vessels, which happens particularly in the cold, then the proportion of water in the urine increases; the urine becomes clear and copious. Only when

complete suppression of the cutaneous transpiration occurs, in greater extent or for a long time, do the kidneys seem inadequate for the removal of the retained water, and other accidents appear, such as plethora, congestions, and secretions. But if, after influences which only a little check the perspiration, another watery secretion appears, instead of diuresis—for instance, diarrhœa—then the organ secreting it was previously irritated, and there is no more a pure sympathy through the blood. But a nervous sympathy also seems to be connected with the antagonism between the skin and kidneys. The necessity of passing the urine is often manifested so instantaneously with the influence of cold, that it cannot be accounted for by the supposition that the urine has accumulated from the retention of water. It is manifested also from an entirely local influence of cold; and the quantity of urine evacuated in consequence of such an urgent micturition, is not so great but that the bladder could have held much more. If cooling the feet relieves obstinate retention of urine, as Hufeland asserts, he can of course mean only retention from spasm of the bladder.

If the secretion of water by the kidneys is primarily augmented, as in diabetes, then the turgescence of all the tissues, and the transpiration, is diminished. The dryness of the skin, even in warm weather, the loss of all effect of diaphoretic remedies, and the costiveness of diabetic patients, seem to prove, that the ordinary stimulating remedies do not so readily excite watery secretions as in the healthy.

Finally, if the function of the kidneys ceases, or if the excretion of secreted urine is checked, or if the kidneys are no longer capable of separating the quantity of water received, then, certainly, the perspiration is augmented, but not necessarily the watery secretions of the skin. General turgescence and even dropsy arise, rather than perspiration or diarrhœa. In order to avoid the former, the latter must be artificially promoted. Here is a remarkable fact, which shows the participation of the vessels in these phenomena of antagonism. If the watery perspiration is for once induced to any extent, then even

the healthy kidneys no longer furnish the usual quantum of water; the urine becomes in the same manner scanty and condensed, as, after considerable watery secretions, a proof that the accumulation of water in the cellular tissue, and in the serous cavities, is kept up at the expense of the secretion of urine. The same thing is demonstrated in the communication between the skin and kidneys. If one is obliged, from the circumstances in which he is placed, to overcome a natural and violent desire to urinate, during which, in consequence of the exertion, a slight perspiration is excited, then is the urine in the bladder no farther augmented, but even its water is partly resorbed, and the urine, when at last it is evacuated, is scanty and sedimentous. It is a crisis, to a small extent, as if the sluices which regulate the course of the fluids were suddenly thrown open, and, once thrown open, are not easily closed again. I mention this here, only to call attention to the fact, that even the most common relations are complicated, in the imagination of our precipitate humoral pathology. I hope hereafter to be able to demonstrate the source of this complication in the lymphatic ducts.

The antagonism between the skin and kidneys is limited, from the fact that the kidney, with the solid matters which it separates from the blood, always attracts to itself a minimum of water. Therefore, in the extremest concentration of the *plasma*, the secretion of urine cannot entirely cease, and even in this case it may be excited by matters being introduced into the blood, which the kidney attracts (*diuretica*).

Of the indifferent ingredients of secretion, I have considered merely water, because this is the only matter whose quantity, in the deficiency of more minute examinations, may be estimated to a certain extent by the eye. Probably the kidney also, in pursuance of its original destination, is the principal organ of secretion for the salts and extractive matters of the blood, and it is not so, only in so far as these matters are previously taken up by accidental irritation of other glands. But then all that I have stated concerning water applies to these matters, with this difference, that in reference to the former the kidneys are not assisted by the perspiration of the skin and lungs. From the

perspiratory and mucous glands to the kidneys, an antagonism takes place, not *vice versa;* that is, the exercise of the kidneys alternates necessarily according to the accidental activity of the skin and mucous membranes, but the secretion of the latter (without regard to the nature of the trifling quantity which continually moistens the walls of glands) is not regulated necessarily according to the activity of the kidneys.

That by virtue of a particular function, special sympathies exist between single glands, of those which I here consider as a totality in antagonism to the kidneys, has been indeed frequently supposed, but without actual foundation. The manuals speak of an antagonism between the salivary glands and the pancreas, so that from suppressed salivation *pancreatitis* originates, and in inflammation of the pancreas, a vicarious flow of saliva; experienced physicians know nothing of this, and *Claessen* has fruitlessly sought for the empirical sources of this tradition. If it were proved of the one or other group of glands, that they attract a peculiar substance to the blood, then a *consensus* between the members of a group might be made probable *a priori.* Such substances are perhaps the sulpho-cyanide of the saliva, the acid of the perspiration, the mucus of mucous glands. But these matters, also, could only be produced in the glands themselves, by secretion from the general ingredients of the blood; their consequence to the organism is not known, and in no case very important, as each of the secretions mentioned may disappear for a long time without detriment.

Arguing according to physiological laws, an antagonism, interposed by the blood, exists between the lungs and the skin. The latter secretes, besides water, volatile sebacic acid, and ammonia, also carbonic acid in relatively less quantity (indeed 412 cubic inches in 24 hours, according to Abernethy); notwithstanding, where the question is with regard to augmentation or diminution of the exhalation of carbonic acid by the lungs, the share which the skin takes in this secretion, should not be, at least, entirely neglected.

The *consensus* between the glands of the blood-vessels among themselves, and between these and the lymphatic glands, is problematical, even physiologically considered. The opinion, that

they support each other, and consequently can represent each other, is founded, firstly, upon their anatomical affinity, and upon the fact that extirpation of the one or the other of these glands is undergone without danger or detriment. That opinion is fortified by Tiedemann's observation, that the thyroid gland is enlarged after extirpation of the spleen; and farther, by the result of the experiments of Schwager Bardeleben, who remarked an inclination to exudations after extirpation of the spleen, as well as of the thyroid gland, but mostly after extirpation of both. But all this only suffices to demand more extended investigations.

In order to complete the statements here made, I must at last mention, that even glands of apparently different function may be associated by the blood, if they manufacture the same element, or nearly the same ingredient of the blood, only each in its own way. The sympathy of the liver, in lung diseases, has been thus explained, for a long time, already; and, in modern times, namely, the frequent complication of phthisis pulmonalis with fatty degeneration of the liver. A restriction of the carbonic acid exhalation operates reflectively upon that organ, *par excellence*, which has to separate the substances abounding in carbon from the blood, in the form of bile. As a farther confirmation of this antagonism between the liver and the lungs, we may adduce the relative size of the former during the embryo life. Such, like Apercu's, are still too deficient to be considered proofs. As yet, it has not been certainly ascertained that the tuberculous lung expires less carbonic acid; and, as yet, by far the most constant symptoms of phthisis, the general emaciation, has not exhibited an excess of carburetted hydrogen in the blood. Therefore, the value of the hypothesis, which forms the basis of this view of the internal connexion of organic changes, remains undiminished.

II. NERVOUS SYMPATHIES.

It is a principle derived from experience, that the nerves communicate their conditions of excitement to each other; and it is proved, that the communication does not ensue within the ner-

vous trunks, but only in the gray substance which lies between and around the nervous filaments, that is, in the ganglia; in the appropriately so-called central organs, the brain and spinal marrow, and the ganglia, (which structures I shall here comprehend under the common appellation, "central organs.") Communication of excitement, in the central organs of the nervous system, is the foundation of all the undoubted nervous sympathies. The laws according to which excitement is propagated in the central organs, are at the same time the laws of sympathy.

It is impossible to demonstrate this propagation in any other way than by that of juxtaposition. This view, forming the basis of the ancient theories of sympathy, must refer to the connexion of the nervous branches in the trunks, or to a connexion of the consensually excitable parts by a peculiar nervous system, the sympathetic. Even among sensitive plants, we see the consequences of irritation spreading from the irritated point; and, for example, in the *mimosa pudica*, after touching one of the feathery leaflets, we see gradually those of the same leaf, and then also those of the neighboring leaves, curl up and close together. And even in inorganic nature, the phenomena of the conduction and communication of caloric, the induction of electricity, &c., present analogous relations. The propagation of any effect to the parts contiguous, is so consonant to our senses, educated by the contemplation of the material world, that the transition of a morbid symptom, of a pain or an eruption, to the parts immediately surrounding it, seems hardly to need an explanation; and the idea of a sympathy, as of a mysterious internal connexion, occurs to us only with difficulty, unless the communication proceeds by sudden transitions to the periphery.

There may be nerves near each other, in the central organs, which diverge towards the periphery; and thereby far-distant parts of the body are brought into the same sympathetic connexion, as if the irritation was propagated immediately from one to the other.

Suppose the origin of the filaments A and B lie near each other in the spinal marrow or brain. Of these, the one went to

the right, the other to the left side; then the irritation of a limited portion of the central organ must produce sensation or motion in both sides. Now, if within the tissue of the central organ, a communication of irritation takes place, as in the above-mentioned cases, then irritation of the filament A is extended to the filament B; and, for instance, pressure alone upon A B determines to *sympathetic* motion and sensation. As sensitive nerves possess the faculty of transmitting their excitement to the central organ, so the effect is the same, whether the nervous filament be excited at the peripheric or at the central extremity, and a peripheric irritation of a sensitive filament, A, must, in the same manner, be communicated to the filament B, and may appear again at the peripheric end of B. If B is a motor filament, then contraction of the muscles, in which it is extended, ensues; and if it is sensitive, then a sensation may be perceived apparently in its peripheric extremity, as it is well known that the sensation is easily transferred to the peripheric extremity, even where the irritation comes in contact with the sensitive nervous trunk at a higher point of its course. Furthermore, it will be hardly necessary to mention, that even in consequence of communicated excitement, each nerve reacts only in its specific energy. The muscular nerve, irritated by the nerves of sight, of hearing, or of feeling, can only bring about contraction; the auditory nerve, sympathetically excited by the nerves of sight or of touch, can only hear, &c.

If our knowledge of the arrangement of the separate origin of the nerves, in the central organs, were complete, then nothing farther would be necessary than to demonstrate, that the nerves which here come in contact with each other, also, *par excellence*, stand in sympathy with each other. But we are yet far removed from such an insight into the structure of the nervous system. The sympathies between the peripheric parts of the body are much better known to us; and if it were only proved, that consensually excitable nerves lie together in their central course, then inversely we might conclude, with much more certainty, upon the structure of the central organ from the sympathies. The proposition, that nervous sympathy may be the result of a

propagation of excitement, according to the contiguity of the nervous filaments, is therefore to be considered as nothing more than an hypothesis, which is more worthy of being adopted, the more frequent, on the one side, are the sympathies between presumably contiguous nervous filaments, and the more probable it may be made, on the other side, that sympathetically connected nerves approach each other at their central extremities.

The conjectures concerning the arrangement of the nervous filaments in the central organs, are founded partly upon anatomical, partly upon physiological investigations. Although facts of either sort do not properly belong to the department of this manual, but must be presupposed as the basis of pathology, still I do not deem it necessary to deprive myself of a comparison and proving of the same. In the rapid development of anatomico-physiological sciences, no work pertaining to them can, even for a short time only, maintain itself as the exclusive source; and in the contrariety of opinions, it becomes necessary to premise a special confession of faith, to every application of any dogma whatsoever. In order not to be too prolix, I shall appeal, as far as is possible, to my Manual of General Anatomy, together with the additions in my yearly reports (Zeitschrift für Rationelle Medicin, Bd. ii., Canstatt and Eisenmann, Jahresbericht für Biologie, 1844–5), and to a treatise by Volkmann, published in R. Wagner's Pocket Dictionary, vol. ii. pp. 476 to 627.

ANATOMICO-PHYSIOLOGICAL PRELIMINARY OBSERVATIONS.

The filaments of all the nerves, and of the medullary substance of the central organs, are divided, according to their effects, into three groups: motor, sensitive, and such as will excite neither motion nor sensation by their irritation, but, on the contrary, seem only to serve the functions of the soul; I shall call them *psychical*. The latter occur independently in the hemispheres of the cerebrum, and in the corpus callosum.

The sensitive filaments are farther divided, according to the specific sensation in which they react; the motor, according to the nature of the contractile tissues, whose motions they produce. If we take into consideration the anatomical structure of the

latter, we must distinguish the nerves of the varicose, of the smooth muscular fibres, and of the contractile cellular tissue. If we regard the physiological properties of the muscles, the division of motor nerves into voluntary and involuntary obtains. In so far as the structure of contractile fibres stands in a definite, but not perfectly constant relation to their physiological property, the corresponding groups of nerves also coincide tolerably, though not without exception. At the same time, the voluntary nerves are the nerves of varicose, the involuntary of the smooth muscular fibres, and of the cellular tissue. Nevertheless, the nerves of the heart and œsophagus, although belonging to varicose muscles, are still not voluntarily movable. In the former division of the nerves into *animal* and *organic*, or *vegetative*, the physiological principle was chiefly considered; and thus animal and organic fibres are tolerably synonymous with voluntary and involuntary motor fibres. On account of this ambiguity, I deem it prudent to suppress entirely the terms animal, organic, and vegetative.

Of the organs which are not under the control of the will, some, with respect to their conduct towards irritants, approximate the voluntary muscles more closely than others; the one are excited by galvanism, and do not react against cold, the others are insensible to galvanism, and contract upon the application of cold. To the first kind belong the viscera, in a narrow sense, so called (the bowels and excretories), and the heart; to the second kind the vessels and the skin. It will be judicious to establish upon these groups corresponding divisions also among the nerves. I shall distinguish visceral and heart-nerves (*organo-motor*), vascular nerves (*vaso-motor*), and nerves of the cellular tissue, and I would have it particularly understood, that the nerves of the heart are not comprehended under the vaso motor or vascular nerves.

Anatomy teaches, that even the fibrous structures, in the widest sense of the word, that is, those formed of cellular tissue, not contractile membranes and ligaments, are furnished with nerves. But it still remains at present undecided, whether these nerves interpose the sensibility of the parts mentioned,

whether they belong to the vessels of the same, or exhaust the tonicity, whose existence is demonstrated by the vacillations between atony and contraction at least in the ligaments and aponeuroses.

We have distinguished the nervous filaments according to the tissues in which they are inserted, and according to their forces; we have still to mention a third principle of division, namely, according to the diameter of the filaments. In this respect they are divided into two classes, coarse and fine, which in many places at least contrast strongly with each other, even when they are transitions to others. In their peripheric expansion all filaments seem to become fine; in the brain and spinal marrow both coarse and fine filaments happen in close proximity; and it may not yet be determined, whether the two kinds have here a different signification, whether they continue on in the corresponding filaments of the trunks, or whether the fine filaments of the brain and spinal marrow, in their passage in the nervous trunks, become coarse filaments, in the same manner as the coarse filaments of the trunks become fine in their peripheric expansion. But in the nervous trunks we see coarse and fine filaments legitimately distributed.

Among the sensitive nerves, the filaments of the higher nerves of sense, like the cerebral filaments, are fine, in opposition to the coarser filaments of the peculiar nerves of touch.

The filaments in the trunks and branches which go to the voluntary muscles, are remarkably coarse, intermixed with only a few fine filaments; the nerves of the heart consist of fine filaments only, and the nerves of the stomach almost entirely of such. The nerves of the skin and mucous membrane exhibit both kinds of filaments, mixed in less constant proportions, and not without transitions; still, the nerves of the mucous membranes seem somewhat more abundant in fine filaments than those of the cutis; the nerves of the teeth and of the bill of birds more deficient in these than the nerves of the free mucous membranes, in which the number of fine filaments may exceed twenty-five times those of the coarse (*nerv. nasalis*). In the branches which go to the glands, the fine filaments seem throughout to be more

numerous than in the cutaneous nerves. The nervous filaments which accompany blood-vessels are always fine.

The inquiry now arises, whether the stated differences of calibre stand in a constant relation, either to the insertion, or to the physiological importance of the nerves? In order to solve the first question directly and anatomically, we must first demonstrate to which of the tissues of a compound organ, for instance, of an entrail or of a gland, the different filaments of a compound nerve go, whether to the sensitive mucous membrane, to the muscular fibres, to the glandular cells, or to the vessels. It is certain only that the calibre of the nerves stands in no necessary connexion with the nature of the muscular fibres, because the varicose bundle of the heart, the smooth fibres of most of the viscera and of the arteries, and the cellular tissue of the veins, are supplied by the same class of nerves.

It follows, from the above-adduced facts, with more probability, that the fine nerves are not the nerves of voluntary motion. Volkmann's experiments teach, that where they happen together, with coarse filaments, in the voluntary muscular nerves, they are not capable, of themselves, of producing contraction of the muscles. On the contrary, the heart receives no others than fine nerves. The fine filaments are proved as nerves of the vessels, by the fact of their expansion in organs in which no other motor apparatus is provided, and by the vascular paralysis which follows section or division of those nervous branches which conduct or transmit fine filaments to the organs. Whether they, besides, supply the smooth muscles of the bowels and excretories, or whether the coarse filaments included in the splanchnic nerves belong to these, is not so easy to decide. If the number of the latter seems inconsiderable, we must remember how seldom, generally, nervous filaments are seen in smooth muscles. We know not, in this species of muscle, how great may be the dominion which is swayed by any single nervous filament. I have seen but one single proof mentioned for the presumption, that the fine filaments may be also organo-motor; and this remains to be corroborated and proved as a general fact, namely, that in the nerves which go to movable viscera, and those supplied with

contractile layers, fine filaments are included in relatively greater number than in the nerves of equally sensitive membranes, but those fastened to solid walls.

But the fine filaments, even if they are never the organs of voluntary motion, are in no case the exclusive organs of involuntary motion. I mention the muscles of respiration, whose motions differ from those of the heart only in so far as they are capable of more voluntary modification. For the œsophagus and stomach, Volkmann likewise adds the exception, that they may include the coarse filaments in more considerable quantity.

Among the fine filaments of the splanchnic nerves, are there *sensitive*, or, to speak more generally, *centripetal* filaments? Volkmann has demonstrated that the fine filaments which are met with in the trunks of the nerves of the extremities, are not sensitive. Direct experiments, by irritation of the splanchnic nerves, teach only that their sensibility is slight; of which the small number of coarse, as well as of fine sensitive filaments, may be the cause. But if organs to which sensibility cannot be denied, or at least the faculty of being aroused to reflected motions, contain no others than fine filaments, then must such organs also be capable of centripetal conduction. Accordingly, among the exclusively fine filaments of the nerves of the heart, and of many fibrous membranes, are also sensitive filaments, which apparently do not differ from the motor filaments.

In regard to the nervous filaments, therefore, we arrive at a similar conclusion as with respect to the contractile tissues, namely, that there are forms microscopically different, and distributed according to typical laws; but that the form alone is not sufficient to ascertain the physiological importance of each single filament.

Let us now turn to investigations concerning the course of nervous filaments towards the central organ, and concerning its relation to the latter. I have only to premise the remark, that here, where anatomical views are discussed, I shall place the origin of all nervous filaments in the periphery, and their termination in the central organs, without regard to the direction which they take.

In general, anatomical and physiological facts teach, that the sensitive and motor nerves are collected in branches and trunks, and, after frequent mutual interchange of filaments, enter the brain and spinal marrow, nearly in the order that they originate peripherically. Thus, for instance, in the thorax, where the formation is the most regular, one nervous trunk corresponds to the cutaneous and muscular nerves of each intercostal space, and the nerves of the vertebral region corresponding to the intercostal space, arrive, with the synonymous intercostal nervous trunk, at the medulla spinalis. Anatomy shows us individual exceptions, as, for example, that the *nervus phrenicus* first ascends through the entire cavity of the chest, in order to mingle its filaments with those of the middle cervical nerves, or that the trunk of the *nervus vagus* contains branches from the auditory region and from the stomach. The nerves of the intestines seem to stand in a similar relation to those of the trunk, if, in the difficulty of following the course of filaments anatomically in man, and in the uncertainty of physiological experiments, we may place any value upon the results of comparative anatomy. In the inferior vertebrated animals, namely, the nerves originating in the viscera proceed in the great tract of the sympathetic a considerable distance upwards, before they are connected with an intercostal nerve by the *ramus communicans.* Accordingly, the nerves of the viscera come from a deeper region than the nerves of the abdominal walls, which come in contact with them in the same trunk. Inversely, the nerves from the tongue, in the *ramus descendens hypoglossi*, and the motor nerves of the *iris*, in the trunk of the sympathetic, go downwards to the trunks of the cervical nerves.

Neither anatomical investigation nor experiment have hitherto given adequate information as to what law regulates the connexion of the vascular nerves to the rest. Where the nerves of motion and sensation of a part are collected in separate trunks, as in the head, the vascular nerves seem to run their course with the sensitive, and partly at least to go downwards in the *sympathicus;* in the nervous plexus of the splanchnia *sensitive, organo- and vaso-motor* nerves, without doubt lie contiguous

to each other; the vascular nerves of the extremities and sides of the trunk may enter partly into their spinal nervous trunks, partly with the arteries into the cavities of the body, and the *plexuses* of the *nervus sympathicus.* One fact may be cited in favor of this view, viz.: that the nerves of muscles which are required in different combinations and for different purposes may be associated in separate branches, over each of which one of the specific functions of the muscular group presides. According to Bernard, the vocal motions of the muscles of the larynx are dependent upon the filaments of the *accessorius*, the respiratory motions upon the *vagus.* After section of the first the vocal cords are no longer contracted, and are not sufficiently approximated, although the dilatations and contractions of the glottis continue isochronous with the respiration.

Among the peripheric nerves the transition of filaments from one lateral half to the other is very unfrequent; we see exact lateral spasms, paralyses, and anæsthesia. The optic nerves perhaps form an exception, if in each root of the chiasmus filaments from both retinæ actually combine, and not rather a complete crossing of collective filaments takes place. The vascular nerves of the surface of the body may be also laterally affected, as is seen in the lateral forms of erysipelas (for instance in zoster), lateral diaphoresis, lateral œdema, or atrophy of paralysed parts, for example, of the face and of the tongue. Among the viscera, on the contrary, the rule is, that the nervous cords of each half of the body draw their filaments from both lateral halves; not merely among the hollow viscera, and those lying in the median line, as the stomach, intestine, urinary bladder, heart, &c., but also those that are in pairs. Thus each *vagus* contains branches from both lungs, which are oppositely interchanged in the *plexus pulmonalis;* so also it is possible, that the nerves of the kidneys, testicles, ovaries, corpora cavernosa, &c., in the single plexus in which they meet, may in part pass over to the opposite side, a fact of course only decided by anatomy and experiment. The consequence of this arrangement is, that destruction of the nervous trunks of one side does not completely paralyse

the organs, and irritation of those trunks has an effect upon both halves.

All nervous filaments at last enter into the central organ, some into ganglia, others into the spinal marrow, others into the brain. Accordingly, in the anatomical sense of the word, they are ganglionic, spinal, or cerebral nerves. It is known of the spinal and one of the cerebral nerves, that they separate their motor and sensitive filaments into two roots, before their entrance into the central organ. Strictly considered, only the motor root should be called a spinal or cerebral nerve, as the sensitive roots go into the ganglia (*ganglia spinalia* and *Gasseri*). But it has always been considered an established fact, and certainly with reason, that these roots only penetrate through the ganglia, and on that account the latter have been described only as swellings on the former.

If through the nervous roots, the filaments of each half of the body enter the brain and spinal marrow, so nearly in the order in which they originate contiguously in the periphery, then also at their entrance into the central organ, the corresponding filaments of both halves of the body approach each other; at least, the insertion of symmetrical filaments takes place in equal rank. The same may not be asserted of the ganglionic nerves. It is true that the ganglia of the sympathetic, and the scattered ganglia at the upper part of the sympathetic, are symmetrically arranged; but the nerves which they receive are not thereby rendered contiguous. On the contrary, many of them, according to the above-mentioned observations, contain a mixture of filaments from both halves of the body. This is so much the more probable if, as in most of the viscera not in pairs, there are single ganglia between the peripheric beginning of the nerves, and the sympathicus, which are perforated by filaments. If certain filaments only perforate the last ganglia of the sympathicus, and after having passed through them, continue on to the central organs, they enter these like the symmetrical nerves of the body.

In general, the point of insertion of the nerves in the spinal marrow is opposite the intervertebral foramen, through which the nerves pass into the vertebral cavity, and the central point

of insertion is therefore on the same level with the intercostal space and the vertebral region, whose filaments convey the nerves to the central organ. It is well known that the lower spinal nerves form an exception, by running a certain distance upwards in the vertebral canal; and the lower the point at which they enter, the greater this distance. The *nervus accessorius* forms a striking exception, in that it reaches the cranial cavity along with the vagus, and then goes downwards with the greatest part of its filaments, and in company with the cervical nerves sends its bundle of filaments into the spinal marrow.

I now approach the most important and the most difficult part of this investigation, viz., to pursue the course of nervous filaments in the internal substance of the central organ. Are the names ganglionic, cerebral, and spinal nerves intended to denote that the filaments terminate, or, according to the usual mode of expression, originate in the organs which they first reach, or are all nerves collected at last in the spinal marrow and brain, or altogether in the brain alone? Both opinions have found their advocates, as is well known; but the true opinion seems (to use an expression as common as the corresponding fact) to lie between the two.

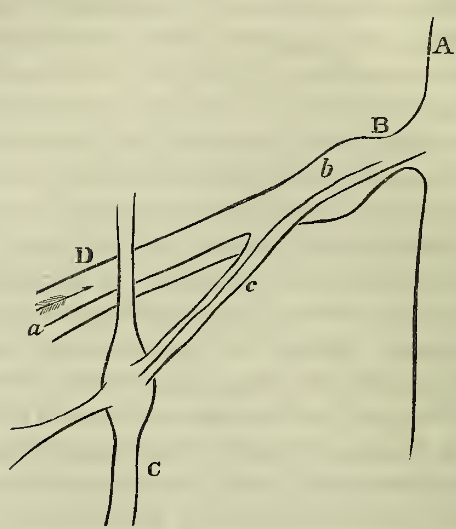
If we confine ourselves to the pure anatomical facts, then we may assert,

1. Of the ganglia, that filaments may terminate in them as well as go through them. One argument for the termination of the nervous filaments in the ganglia may be drawn from a comparison of the mass of nerves which enter them from the periphery, with the mass of so-called roots, that is, of the branches running from the ganglia to the spinal marrow; a comparison which has never been exactly instituted except in frogs, and in all probability would give a much less decision in favor of the peripheric nerves, among the higher vertebrated animals. Another argument for the termination of nervous filaments in the ganglia may be adduced from the transition of nervous filaments into the ganglionic bulbs, determined by the aid of the microscope, as well of the spinal ganglia as of those belonging to the sympathetic system; perhaps also the convoluted form of the nervous

filaments within the ganglia may be considered as an evidence of their termination in them. But the coarser organization of the *ganglion Gasseri*, the spinal ganglia, and many others, teaches us that a number, and sometimes a considerable number, of the filaments entering the ganglia merely pass through them, and corroborates the miscroscopic analysis of the smaller ganglia. Anatomy only leaves us in doubt, or at least gives us no tangible conclusion, with regard to the ganglia of medium calibre, as, namely, those in the great tract of the sympathetic. In regard to these ganglia, all that can be said concerning the proportion of filaments entering them to those issuing from them, is for the most part mere conjecture. A consideration of the form, that is, of the calibre, of nervous filaments, furnishes some points of support. Still, as we have never seen any other than fine filaments terminate in the ganglionic bulbs, and as the coarse filaments of the peripheric branches and those of the roots nearly correspond in number, so should these coarse filaments be considered as perforating the ganglia and continuing on to the spinal marrow. The question whether they arrive there by the anterior or posterior roots, or by both, is still undecided by the data hitherto obtained, and awaits its solution by the microscope. In regard to the fine filaments, which lie in the connecting branches of the sympathetic nerve, and of the intercostal nerves, it may be said that their course is of a triple kind, as is represented in the following cut; one part (*a*) comes from the peripheric portion of the intercostal nerves (D); another part (*b*) remains in the spinal ganglion (B); a third row of filaments (*c*), (in the higher vertebrated animals more numerous than in reptiles), appears to perforate the spinal ganglion, and to enter into the medulla spinalis or brain (A). These are the ones, therefore, with regard to which it should be decided, whether they are continuations of those entering into the sympathicus (C) from the periphery, or new filaments establishing a connexion between the ganglia and the spinal marrow, or lastly, whether they arrive from the central organs, as the place of their peripheric expansion, and terminate in the ganglia. Anatomy teaches nothing determinate on this point; it furnishes only one fact, which

at the least is not favorable to the last explanation, that, namely, in the spinal marrow of the frog fine filaments termi-

Fig. 2.



nate in the ganglionic bulbs. But the theory which derives the fine filaments collectively from the sympathetic system, and at the same time makes them the organs of involuntary motion, fails to apply in the nerves which, arising from the spinal marrow, set in motion the lymphatic heart* of the frog; because either those nerves consist of coarse filaments, and then involuntary motions may depend also upon coarse filaments, or of fine, and then fine filaments also arise from the spinal marrow.

2. We may demonstrate, in regard to the spinal marrow, upon the same grounds as in regard to the ganglia, that it does not conduct all fine filaments to the brain. The spinal marrow does not increase in size from below upwards, as must be the case if all the nervous filaments entering it pursued their course in it to the brain, and the mass of white substance in the cervical region would be far exceeded by the mass of accumulated spinal nerves.

* In the frog and some other amphibious animals there is an organ which has some resemblance to a heart, and which receives the lymph from the vessels and contracts and expands alternately.—Trans.

The termination of nerve-filaments in the ganglionic bulbs of the spinal marrow, is demonstrated in the same manner as has been mentioned. But whether any filaments at all pass over from their point of entrance uninterruptedly through the spinal marrow and into the brain, is more difficult to decide than in the ganglia. Most of the microscopical observers are certainly of this opinion; but it is, as Volkmann rightly objects, always a comparatively slight depth only, to which nervous filaments have been pursued in the spinal marrow. Anatomical investigations are not adequate, therefore, to disprove an hypothesis which would maintain, that all peripherically-entering filaments terminate in the spinal marrow, and that the medullary substance of the spinal marrow itself consists of new filaments.

Where anatomical investigation does not suffice, we have in *physiological experiment*, be it arranged by us designedly or by accident, a means of pursuing the course of nervous filaments. The result is the same, whether we irritate a nervous filament at its peripheric extremity, or high above in the trunk, or in the roots. So far as the consequence of an irritation of the central organ resembles the consequence of irritation of the trunk and roots, so far have we to deal with continuations of entered nerves. Upon this reasoning is founded the ancient opinion, that the nerves of voluntary motion and of sensation of the collective parts of the body ascend in the anterior and posterior cords of the medulla spinalis, and then, after being crossed, may be contained in the medulla oblongata, and even in the crura cerebri. This supposition lies at the foundation of the truly inefficient attempts to prove a transition of the motor nerves of the sexual parts, digestive organs, and heart, into the spinal marrow and brain. That, moreover, all the nerves of the viscera do not terminate in the sympathetic, is already proved by the example of the motor filaments of the œsophagus and stomach, which are conducted in the roots of the vagus to the medulla oblongata.*

* We may safely commit to time all decision upon the correctness of individual facts. But when Volkmann attacks the principle of classification itself, and adopts a system of peculiar spinal-marrow filaments which place the brain

Farther, as nervous filaments, without connexion with the gray substance, soon lose their powers, so the destruction of the central organ or section of its nerves, likewise affords a means

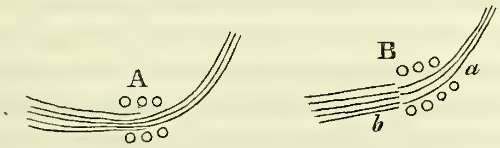
in connexion with the peripheric nerves, then it must be asked, what could determine him to prefer this hypothesis to the ancient and generally-received opinion? First of all, it was the fact, that from the ganglia to the spinal marrow, and from the spinal marrow to the brain, the mass of nervous filaments decreases; but this entirely agrees with the theory, that one part of the entering filaments terminates in the ganglia and the spinal marrow. Therefore, Volkmann's peculiar views seem to arise from the sense which he connects with the term "central organ." According to our anatomical definition, a central organ is a structure, within which nervous filaments are surrounded by ganglionic bulbs, and partly, as I must now add, pass over into ganglion bulbs. His physiological meaning is, to preserve in activity the nervous filaments, and to bring about the reciprocal transference or the antagonism of their conditions of irritation, according to certain laws, whereby it is indifferent whether the filaments terminate in the central organ or continue farther on. Volkmann calls "central organ" a regulating apparatus, which places a multitude of single forces in suitable connexion for the accomplishment of one organic design; and as he is obliged to designate, in this apparatus, a definite seat for each complicated motion, he judges it probable that the central organ for each motion is in the point of origin of the compound nerves; in other words, that the nerves terminate in the central organs, in which they are associated for a common object. But he himself remains not true to this opinion; because, whilst he must transfer the extremity of the cardiac nerves to the ganglia in the substance of the heart, which still determine to rhythmical pulsation the cut-out and isolated heart, he nevertheless considers with us others, filaments of the nervi cardiaci as the motor nerves of the heart; and thus, if really in the spinal marrow lies the cause of the association of many muscular nerves, and of the preservation of its tone, he is still obliged to acknowledge, that the filaments of the crus cerebri may be continuations of the filaments entering into the medulla spinalis. So far, the question is with regard to opinions. Nevertheless, Volkmann takes into consideration one circumstance, which might possibly obtain as a proof of his theory. Nerves divided without the central organs, as is well known, lose their irritability and tone, whilst, after a transverse section of the spinal marrow, those nerves issuing below this point of division become indeed paralysed, as far as the will is concerned, but retain their tone. Volkmann, by attributing the loss of irritability in the first case directly to the operation and destruction of parts, argues, from the maintenance of tone in the second case, that the section could not have touched the nervous filaments themselves. But even this explanation cannot be correct; because if, in the first case, the section destroyed the nervous filaments, then their function could not be re-established by the healing over of the intersected parts, nor could the sensitive filaments in the central

of ascertaining the course of the nervous filaments in the central organs; it is true, only a very limited means. If the tone and function of a nerve perishes after the destruction of a central organ, this only proves that between the destroyed central organ and its peripheric extremity, the nerve penetrates no gray substance; but it does not prove, that this nerve does not ascend farther to the brain on the cerebral side of the destroyed central organ. On the other hand, if the tone of a nerve is preserved after the destruction of a central organ, it is not thereby proved that it has not been included in the destroyed central organ, but

trunk remain vigorous, as is mostly the case. Then the exsected and divided heart should not continue to pulsate.

In respect to physiological effects, it is moreover tolerably indifferent whether one confines himself to the ancient or to Volkmann's modern hypothesis. The new and important fact which his and Bidder's observations have taught us is, that the mass of filaments beginning from the brain, increase in the spinal marrow and ganglia. This may be represented by the two accompanying diagrams. According to fig. A, the perforating filaments conveyed the

Fig. 3.



excitement which took place in them to those contiguous to them. According to fig. B, the excitement from the three entering filaments passed over equally upon the five issuing. In both cases preparation must be made, that the special issuing filaments receive the irritation of the special entering or perforating filaments. In the same manner, in an inverse order, if we consider the filaments as sensitive, their number would be reduced towards the brain. Volkmann supposes still a third possible case, namely, that the entering filaments (*a* in fig. B) are to the central organ, from which the new issuing filaments (*b*) arise, as centripetal, conducting the irritant from the brain or spinal marrow. This appears to me a mere play with words. The motor filaments, in reference to the muscles in which they enter, and which they excite, might with equal right be called centripetal. Whatever motions are effected by the sensorium, no matter whether directly or indirectly by temporary translation of the irritation upon a more peripheric central organ, operate in centrifugal direction.

only that it finds new masses of gray substance between this organ and its own peripheric extremity. These results would be tolerably positive, if the preservation or annihilation of the tone were alone to settle the point: but, in many cases, the question is with regard to a *plus* or *minus*, with regard to mere restrictions of energy, partial paralysis, or retarding of the rhythm; and when this is the case, we should not directly conclude that the nerve-filaments to be examined, may have been connected with the ganglion bulbs of the destroyed central organ, because each destruction of large masses of gray substance depresses, in the widest sphere, the forces of the nervous system. Now, if we reflect, how the facts derived from experience in man and the higher vertebrated animals, are continually thrown together with the result of experiments on reptiles, whilst a comparison of the sympathetic and cerebro-spinal nervous masses in both classes of animals must lead to a difference in the signification of the central organ, then we shall readily be able to explain the contradiction of opinions which prevail in this department. If we destroy the brain and spinal marrow in frogs, and preserve only the medulla oblongata, still the circulation and the motions of the digestive organs may be sustained for a long time. But to argue herefrom, that the ganglia of the sympathetic alone govern the said motions, is inadmissible; because the medulla oblongata could equally well distribute nerves to the heart and intestinal canal as to the muscles of respiration. The sympathies of the viscera, hereafter to be mentioned, render this very probable indeed. Again, in frogs, the bladder seems to receive its nerves directly from the spinal marrow, as it becomes paralysed after extirpation of the spinal marrow. The infiltration and gangrenous destruction of the lower extremities of the frogs operated on, which might have been considered as a proof of the dependence of circulation upon the spinal marrow, may now be explained as the consequence of increased activity of the lymphatic heart, which is set in motion by the nerves of the medulla spinalis. The action of their lymphatic heart is particularly interesting, on account of the conclusive results which the experiment affords. This is seen, namely, at a deter-

minate and limited spot in the cervical and lumbar portions of the spinal marrow, in which the nerves, on the one side of the anterior, on the other of the posterior cords, enter into the lymphatic heart, and terminate, and become combined to produce the desired motion.

In regard to the higher vertebrated animals, we may appeal to the effects of the loss of the brain and spinal marrow, as authentic proof of the independence of the sympathetic nervous system, and in fact there is no doubt, that the integrity of the brain may not be an indispensable requisite for the motions of the vegetative organs. It may not be argued with equal certainty, that the spinal marrow is not indispensable, because it is related of children born without a spinal marrow, that they lived hours and days, breathed, took nourishment, and moved themselves, but we should do well to receive these observations with some mistrust. On the other hand, paralysis of the rectum and of the urinary bladder, after a wound and degeneration of the lower part of the spinal marrow, is something very common, and we should not attribute the retention of stool and urine in these cases to paralysis of the abdominal muscles, if we remembered how frequently, after opening the abdomen, animals still discharge excrement and urine. A case of Roberton testifies to the influence of the cervical portion of the spinal marrow upon the motions of the heart, where after a wound of the upper cervical vertebræ, which injured the vertebral canal, attacks of syncope occurred with extraordinary slowness of the pulse. The observation of Buniva, that injections penetrate into the arteries of living animals only when the spinal marrow has previously been destroyed, seems to me inexplicable, if we do not admit the influence of the spinal marrow upon the tone of the arteries; and the same is the case with the remark of Schrœder, of Kolk and Platner, that the destruction of the spinal marrow prevents disgorgement of the arteries after death. In proof of the dependence of the vascular nerves upon the brain and spinal marrow, we may farther adduce,—the excretions of persons hanged, and of paraplegic persons, the œdematous swellings in the epidermis, and particularly in the serous and mucous membranes of parts which

are paralysed by injury of the spinal marrow, or lie within the affected parts, the inflammations and ulcerations in the kidneys and the mucous membrane of the bladder after injuries of the medulla spinalis, perhaps also the extensive abdominal inflammations which Schiff observed after section of the *thalamus nervi optici.* I will also here mention the inflammation of the *uvula* connected with inflammation of the cervical portion of the spinal marrow, the peritonitis and nephritis connected with inflammation of the medulla spinalis, the gastro-enteritis in hemorrhage, inflammation and ramollissement of the brain and spinal marrow, the softening of the stomach in meningitis of the base of the brain, &c., and I reserve to a later period more detailed investigation of the internal connexion of these collective phenomena.

If, in view of the above mentioned facts, the efficacy of the brain and spinal marrow appears inadequate for the accomplishment of involuntary motions, then let it be remembered, that the function of the organs may be preserved for a long time, and in certain intensity, by the forces of the ganglia alone, and those of the filaments newly entering them. Here all seems to depend upon the proportion of the accessory gray substance in the ganglia, and in the nerves taking root in them, to the number of nerves which, originating from the brain and spinal marrow, only perforate the ganglia, and to the power which these nerves bring with them from hence. A comparison of the different results which follow destruction of the spinal marrow in frogs and mammalia, may serve directly to illustrate this proportion ; the action of the eye after cutting the nervus trigeminus furnishes another instructive example, where the vascular paralysis is less considerable and permanent if the trunk of the nerves is divided between the brain and ganglion, than if it is divided between the ganglion and the eye, because in the latter case all, in the former only a part of the vascular nerves are hit. Entirely consonant with this, and to be explained on the same principle, if it is authenticated, is the observation of Schiff, that frogs survive fourfold longer the division of the connecting branches between the spinal marrow nerves and the abdominal portion of the sympathetic (in which the filaments arising from the spinal marrow

and ganglia lie) than extirpation of the sympathetic itself. In the ganglia, therefore, the nerves of single organs attain a more or less considerable growth; accordingly, the organs are more or less dependent, that is, the reaction upon irritation of the filaments entering the brain is more or less certain, and after destruction of the latter, the function of the former continues more or less powerful and permanent; hence finally the action of the brain and spinal marrow is either an indispensable condition, or only an accidental occasion of the activity of organs. In the first case, the excitement of the viscera is represented through the brain and spinal marrow, as a necessary consequence; it follows, even when the nervous filaments shall suffer an interruption within the ganglia, as well as in continuous filaments; it deserves, therefore, according to the above given definition, not the name of sympathetic, but of consecutive excitement. In the second case, where the excitement of a less number of cerebro-spinal filaments can and must be transferred in the ganglia (probably through intervention of the gray substance), upon a greater number of ganglionic filaments, the communicated activity acquires the character of sympathetic.

The same relation which exists between the spinal marrow and the ganglia, is repeated between the brain and spinal marrow. A filament of the spinal marrow may pass over, uninterruptedly or by intermissions which do not prevent a continual conduction from the base of the brain, where it lies exposed to the influence of the brain, into a filament of the nervous roots, and be simultaneously determined to communicate its excitement to other filaments originating deeper in the spinal marrow. This communication may be necessary or accidental. One single filament of the spinal marrow may represent as many peripheric filaments as are always and invariably put in simultaneous activity by irritation from the brain. On the other hand, it must be assumed with regard to nervous filaments, which, even if frequently associated, are still excitable by the will, or by irritation of certain isolated parts of the brain, that they also in their anatomical reference to the brain may be co-ordinate. If we estimate the structure of the spinal marrow according to these

fundamental principles, then, among the higher animals, at least, the number of voluntary motor filaments which first begin in the medulla spinalis need not be very considerable, because the collective filaments of a muscle are not all necessary at one time to an invariably simultaneous effect, as is seen in the flexors and extensors of the fingers, in the sphincter muscle of the mouth and of the eyelids and others.

I have hitherto noticed only the possibility of the augmentation of motor filaments in the spinal marrow and ganglia; it still remains to consider, whether the newly entering filaments be not partly *centripetal*, that is, whether centripetal filaments can terminate already in the ganglia or in the spinal marrow. Such filaments then would not be fit for conscious and distinct sensation, and we must conjecture, either that they act like excito-motor filaments in exciting reflex motions, or that they transfer their conditions of excitement in common with other peripheric sensitive nervous filaments, to a single spinal-marrow filament.

The first conjecture is allowed because it may not be disputed, but it is not offered. It is therefore agreed to ascribe the conduction to the central organs to the sensitive nerves, by means of which, upon irritation of the external parts of the body, motions are effected. On the other hand, it is very generally supposed that the reflected motions of the viscera are owing to the influence of appropriate, centripetal nerves, because it is assumed with regard to the viscera, that in a healthy condition they have none, or a different kind of sensibility, from that of the external parts of the body, and that only in diseases a new conducting medium is established between them and the sensorium. In my opinion, the nerves of sensation of the viscera are not different from the sensitive filaments of all other peripheric parts of the body. The viscera under some circumstances are sensitive, therefore sometimes send filaments into the brain. If we have no consciousness of the internal organs of the body except in disease, this does not prove that these parts have no sensation except in disease. So also we could never become acquainted with the condition of the external sensitive nerves, if they were affected in like manner. Only because their energies are changed by causes

which we know, do we turn our attention to them, and learn to separate them from the chaos of common sensations. In disease, the organ which previously felt no particular sensation does not become sensitive, but its idiopathic sensation becomes changed, it forces itself upon tho consciousness, and becomes of an entirely different character, which may be described when it agrees in quality with sensations of the external nerves of touch. But in general, how should we ever be made conscious of changes of the sensations, if the normal condition of repose were not in any manner made known? It is said that the sensations of the viscera in reference to locality are less definite than those of the so-called nerves of touch. This also depends upon an illusion, because the sensations of the skin are referred directly to locality. They acquire a certain degree of determinateness only when we scrutinize them by means of conscious motions, or by the sense of sight. No one knows, immediately and at once, which fingers rest upon each other, when he clasps his hands together behind his back; he only knows it, when he moves the fingers one upon the other, and thus, as it were, counts them. There is no more reason to suppose, that the sensations of the viscera according to their quality should be obscurer than those of special sense. The splanchnic nerves, like those of different parts of the trunk, have their specific irritants, and their specific sensations, and these are subjectively as clear as any sensation can be; the difficulty lies only in their reproduction and representation: because there is only one way of explaining a communicated sensation, viz., to excite the same in others directly, or by representations. There are obscure, peculiar odors and tastes, as there are obscure sensations in the viscera, if we do not know the substance or how to call it which affects the sense, and in the same manner there are intelligible sensations in the bowels, if they resemble pains of external parts which may be connected with definite representations. Such representations are *sticking*, *burning*, *pressing*, *tickling*, *boring*, *beating*, *drawing*, &c., all derived from certain impressions, which depend upon intuitive perceptions. Finally, the vivacity of sensations depends, among those of equal calibre, only upon the number of

the nerves which are extended over a definite space, and upon the kind of nerves that are exposed to the impression. Consequently different regions of the skin have not like sensibility, and seem to yield it almost entirely to other tissues.

For these reasons I may not, in a peculiarity of the structure or of the termination of the sensitive nerves in the sympathetic system, seek the cause, why impressions upon the same, in the rule, are not made conscious, but only interpose motions. If a filament of the sympathetic can ever make conscious one definite impression of sense, then it must conduct itself like the sensitive filaments of the cerebro-spinal nerves ; only there it is the rule, here the exception, and *vice versa*, because even in the animal system motions are effected by unconscious, sensible impressions, as, for instance, the iris is contracted by strong light, even in the careless gazing in the distance.*

But the viscera possess genuine sensitive nerves, and although they may be less in quantity than those of the external skin, still they are equally sufficient to explain the violent pains in diseases of the bowels, as to explain their reflex motions : reflex motions may be interposed even in the ganglia, if the gray substance leads to the ganglia, although the sensitive filaments do not end there, exactly in the same manner as the sensitive filaments of the epidermis are able to occasion reflex motions

* It seems to me that this opinion which I have for years advanced, should not be shaken by the reasons which Volkmann adduces for the old and prevailing theory. The want of sensibility towards heat and cold in the stomach, in comparison with that of the cavity of the mouth and œsophagus, he explains as a result of the relatively less number of sensitive filaments in the mucous membrane of the stomach. That an acute-angular body, for instance, a plum-stone, swallowed is not felt in the stomach, certainly depends upon the same cause, as that a kidney stone excites pain only in its passage through the ureter, and not in the capacious urinary bladder. But I must, at least, acknowledge the teleological consideration, that the insensibility of the abdominal viscera might be designed to spare our consciousness a multitude of representations, which would hinder the concentration of attention upon external things. Because if our thoughts can for once steer their course undisturbed by the thousand changing impressions upon the external sense, and under a number of motions voluntarily to be maintained, then it cannot depend upon an increase of the internal, weaker and more uniform sensations.

through the spinal marrow, notwithstanding they pursue their course as far as into the cavity of the cranium.

The vessels conduct themselves otherwise. These, particularly the arteries, in a healthy condition, appear to have not a mere dull sensibility, but absolutely none. It is possible, that in the violent pain of inflamed vessels the surrounding cellular tissue has more share than the vascular membrane itself. Hence, if we must deny that these have appropriate nerves of sensation, and at the same time allow ourselves to prove that irritations of the vascular membrane occasion contraction of the vessels by way of reflection, then have we a right to define the nerves of the vessels ending in the ganglia or the spinal marrow as excito-motor, that is, centripetal. I shall consider this question again.

The second of the above-mentioned suppositions, that, namely, a number of peripheric filaments, after their entrance into the spinal marrow, somehow or other coalesce into one single filament, which accomplishes the connexion with the sensorium, is, according to the prevailing physiological views, supported by the observation that a greater or lesser number of peripheric points, simultaneously irritated, impart the sensation of one single point. If, in pursuance of these views, sensation took place at the central extremity of the sensitive filaments, and if, on that account, the excitements which one filament meets with in different places must coalesce in one single sensation, then the combination of the irritation of several filaments in one sensation would be an evidence of the union of these filaments in one central filament. But the premises of this conclusion are not admitted. I have called attention to this fact once before; and now Volkmann has to prove by evidence that in aliquot parts of the same filament separate sensations can take place. And thus, therefore, vanishes even this argument for the termination of sensitive filaments in the spinal marrow.

With this small share of anatomico-physiological material, I now return to the nervous sympathies, and shall discuss them

conformably to the anatomical relations which appear as the most probable from the above-furnished representations. We have gained thereby, not only a definite principle of division for the sympathies, but also, as the phenomena of sympathy may be easily arranged and explained according to the adduced hypothesis, an important accession of supports for the hypothesis itself.

In the course of this investigation,—partly from design, partly because, with the best intention, it cannot be avoided,—I shall not always rigidly confine myself to the idea of sympathy. It is not always easy to diagnose whether a condition is sympathetic or antagonistic. In order to be able to call the condition of excitement of a nerve sympathetic or antagonistic, we must have known it as the consequence of a change originally introduced in another nerve. It is no phenomenon of sympathy if two organs simultaneously become affected by the same cause. Therefore, if the nerve A is not excited by known external influences, it is well never to decide with certainty whether the excitement of B is a consequence of communication from A, or whether one cause operates in both at the same time. Thus, for example, the involuntary motions and sensations which are associated with a voluntary or spasmodic contraction may be equally well founded in a transition of the excitement of one filament to another, as in the fact that the psychical intention, or an organic disturbance, extends its influence immediately upon the collective filaments. I shall endeavor to apply, in individual cases, all that may be of service in ascertaining the true internal connexion; as for the rest, it is allowed to discriminate somewhat less scrupulously, because the predisposition to become affected in common and the sympathetic connexion, for the most part, depend upon the same anatomical cause,—upon the contiguity of the nervous filaments in the central organs.

The association of certain nervous provinces, from internal causes, might be adduced directly as a proof that the conditions of sympathy exist between them, if the two following circumstances were not allowed to mislead the judgment.

1. It is a fact that, even without the central organ, many

and determined filaments in the nervous trunks, are in common changed by one cause. This has been known for a long time, but it has not always been regarded; and, for instance, in the so-called spinal irritation, we have entirely ceased to inquire whether the source of irritation which is manifested by spinal and intercostal pain lies in the nervous trunks or in the central organs. The first is ascertained sometimes by direct examination, by the discovery of a tumor, caries, and other things. The second has its seat of disease, more probably, in the central organs, when the symptom is extended over several nervous trunks, and alternates between them; nevertheless, any morbific influence, as pressure in the intervertebral foramina, may also be extended upon a number of nervous trunks. Where other points of support fail, the arrangement of the filaments, so far as it is different in the nervous trunks and in the central organs, furnishes a criterion equally inadequate. The sensitive and the different kinds of motor filaments are always more isolated in the central organs than in the nervous trunks; disease of the one kind, without participation of the others, is therefore possible more readily from the central organs than from the trunks. However, it is directly by means of sympathies that central affections become similar to affections of the trunks; and, with regard to the sensitive and motor filaments which are collected in the trunks and arranged together, experience teaches that their reactions may differ very much, at least in intensity and character. We find, in compression of the nervous trunks, at one time paralysis of motion and of sensation, at another time augmentation of both, but also, at another time, numbness of sensation, or formication, with convulsions and rigidity, or, finally, pain (which certainly may exist simultaneously with anæsthesia of the peripheric extremity) and muscular paralysis.

2. We are accustomed to confine ourselves to the explanation of the combination of nervous affections by mechanical force, and to seek out the locality where the filaments lie expanded in such a manner, that "one blow strikes a thousand connexions." But if there were causes which chemically, perhaps through the blood, operated only upon one or the other kind of nerves, or

altogether upon the tissues which the nerves supplied, then a co-operation and sympathy might happen, of which the central parts and the particular course of the filaments would be entirely innocent. Analogy is not opposed to such an admission, because in fact there are nerves which are changed exclusively by the light, or by trifling differences of temperature; irritants which have no effect at all upon the other nerves. We are acquainted with poisons, like lead, which pre-eminently cause contraction in the organic nerves, or even in the organic muscular fibres. This fact is explained by adopting the theory, that the lead has a particular relation to one region of the central organs, from which the nerves of the viscera and vessels arise; but it is explained equally well by the supposition, that a particular chemical relation exists between that substance and those organs, and it will be necessary to fix proper limits in considering even this hypothesis.

In conclusion, without entering into a more detailed analysis of individual cases, I must remonstrate against the convenient fashion, which despatches every participation of certain nerves in organic affections with the name of a nervous sympathy. Pain and paralysis originate, without co-operation of the central organ, from the pressure alone which the dilated and distended viscera make upon the contiguous nerves; for instance, the pelvic organs upon the *plexus lumbaris* and *sacralis*.

In order to separate the certain from the hypothetical as far as possible, I shall particularly discuss the sympathies of each group of nerves. In every successive group, the sympathies of the nerves belonging to it shall be enumerated among themselves, and with the nerves of the preceding group. These are accordingly divided into five classes:—1. Sympathies of the acknowledged cerebro-spinal nerves, that is, of the sensitive nerves of the external parts of the body, and of the voluntary motor nerves, with exception of the brain. 2. Sympathies of the splanchnic nerves, sensitive and motor. 3. Of the nerves of the cellular tissue. 4. Of the vascular nerves. And, 5. Of the psychical nerves.

I. SYMPATHIES OF THE CEREBRO-SPINAL NERVES.

The spinal marrow consists of two equilateral halves, each one of which consists of an anterior and posterior cord; of which to the former, if not exclusively, still pre-eminently belong the motor nerves; to the latter, in the same manner, the sensitive nerves. In the centre, in the space enclosed by the four cords, lies the gray substance, through which communication between the filaments of the white cords becomes possible.

There may be distinguished, therefore, three dimensions, according to which communication can take place. It proceeds, namely, from the irritated point:—1. In breadth, to the corresponding cord and nerves of the other side. 2. In length or height, along the same cord, to a higher or lower homonymous nerve. 3. In thickness, from one cord of one side to the other cord of the same side. Suppose that a sensitive nerve is excited from without, then the excitement is next communicated either to the corresponding, symmetrical, sensitive nerve of the other side, or to the sensitive nerve of the same side lying next higher or lower, or, finally, to the motor nerve of the same side lying in equal height. All sympathies may be referred to one of these three kinds of communication.

It may not with certainty be anatomically demonstrated, how far the cords of the spinal marrow penetrate into the brain; but, according to physiological phenomena, we may represent the cerebral nerves in the same relation to one central trunk interposing the conduction, as the nervcs of the spinal marrow. The laws and dimensions of communication are the same.

I shall examine these three kinds of communication separately, and first in detail the phenomena of sympathy, in the narrow sense of the word (synergy), then those of antagonism, &c.

A. SYNERGY.

1. *Symmetrical communication between the corresponding nerves of both sides of the body.*—This may be demonstrated with certainty in the posterior *cords*, when, for example, in carious toothache of one side, the corresponding although healthy

teeth of the other side are attacked with pain. Ollivier mentions a case where by a wound of the spinal marrow in the cervical region, the left leg, and the left half of the abdomen as far as the median line, had become so far insensible, that pinching, cutting, and sticking needles in the skin occasioned not the slightest pain, and only extensive contact, as the laying upon and moving about of the flat hand excited a very obscure sensation. This patient asserted, when the skin of the left side of the abdomen was pinched, that he had a feeble sensation thereof in the corresponding part of the right side. It is well known that the size of the pupils in each eye adjusts itself according to the amount of light, to which both retina are exposed. If one eye is closed, the pupil of the other eye becomes dilated, although the impression of light upon the latter is not thereby changed, and even the pupil of an amaurotic eye is contracted by the light irritant, which affects the healthy eye. We may refer this phenomenon to a sympathy of both retinæ, but it may also be referred to the association of the motor nerves of both iris, of which I shall speak hereafter.

It is more difficult to ascertain, at least for the voluntary nerves, whether communication also takes place among symmetrical motor nerves. Associated motions certainly ensue very readily in symmetrical muscles, so much so that either homonymous muscles are always contracted simultaneously, or at least, by the intentional motion of the one, that of the other follows without intention, and is even difficult to avoid; but as it is unknown in what way the will operates from the sensorium upon the muscular nerves, it might be objected, that the associated motion originates from a common excitement of both nerves through the irritant of the will, operating on both in like manner. Therefore it may still be adduced, that symmetrical sympathetic motions may be interrupted by a strong effort of the will; but that we can never directly overcome the symmetrical motions of those muscles, whose isolated action can never be adapted to the end in view, as the recti abdominis, the two halves of the diaphragm and others. But even paralysed muscles, and those deprived of the influence of the will, contract simultaneously with

the homonymous muscles of the other side, if these are voluntarily set in motion. In a hemiplegic patient examined by Marshall Hall, extending and elevating the right arm occasioned unconscious motions of the left, paralysed arm. Magendie paralysed the right half of the body of a dog by dividing the right pyramidalia, and observed, that in the attempt to lift up an extremity of the left side, the corresponding right one was at the same time drawn forwards. Stilling finds that in cats and frogs entirely similar motions are executed with both hind extremities, even when one lateral half of the spinal marrow has been divided in the middle of the back, and even when the posterior roots of the same side, outside of the medulla spinalis, have been cut through. I find in Melchior (*De Myotomia Oculi*), a remarkable experiment, which shows a sympathy between the symmetrical muscles of the eye not usually associated in voluntary motions. When the rectus internus muscle of one eye was divided in a dog, it deviated only a little from its natural position; on the contrary, when the same muscles of both eyes were divided, then both eyes were powerfully drawn outward.

Here is the most proper place to consider the complicated morbid conditions which are developed in organs that are in pairs or in symmetrical regions, together with their peculiar nervous symptoms, and to investigate what share the nervous system has in these symmetrical morbid affections.

The predisposition of symmetrical parts of the body to be diseased in like manner, is explained in many cases from their similar relation to the morbific cause, and then to the blood, a relation which may be mechanical as well as chemical. Thus the remarkable, but abundantly corroborated observation of Bizot, that atheroma and ossifications of the arteries are in the great majority of cases perfectly symmetrical, is very comprehensible, if we reflect upon the influence of the heart's beat in this degeneration, which must be nearly alike in the corresponding arteries of both halves of the body. The eyes, the kidneys, the breasts, and other glands that are in pairs, by virtue of their specific tissues, stand in such a peculiar relation to the blood, that we are not surprised, if from certain alterations of the latter,

not only the one or the other of these organs, but also both simultaneously have to suffer. But for many other symmetrical diseases no such explanation seems to be suitable. We cannot understand why single cutaneous regions, single joints, or single bones should be selected in preference to other cutaneous regions, joints, and bones of the same half of the body, and yet symmetrical affections are not unfrequent in these structures. Tumors and other degenerations are often developed with astonishingly like result in corresponding single joints; rheumatism proceeds in a similar course upon both halves of the body. Erysipelas and lepra, and even eruptions produced by the internal use of many medicaments, for instance, kali hydriodicum, spread over symmetrical surfaces.

I think that these phenomena, as well as those defects of nutrition which are limited to exactly one-half of the body, authorise us to concede to the nervous system a greater participation in the diseases concerned, than has hitherto been allowed. The more certain it is, that the cause of local affections is propagated and conveyed through the blood, so much more need is there of farther explanation, why the influence of this general morbific agent obtains only in determinate places. A particular disposition in these places must be assumed; but, in the present case, what else besides the nerves should dispose both halves of the body in like manner, I confess I cannot imagine.

2. *Communication, ascending and descending in the same cord*, therefore from sensitive to sensitive nerves of the same side, from motor to motor nerves.

In treating of the extension of sensation in the same organ of sense (irradiation), we are naturally limited to those senses which transmit impressions capable of extent, viz., sight and touch. It is usually considered as a consequence of irradiation in the retina, that white surfaces seem larger to the eye than black ones, for instance, the illuminated part of the moon seems to belong to a greater circumference than the dark part. In the majority of cases, and perhaps always, this phenomenon has another, purely physical cause. If the images are not delineated

with entire accuracy on the retina, and the clearer circles of divergence and the darker surfaces shade each other, then only the clearer light is perceived and not the more obscure, and on this account the lighter surface seems larger. On the other hand, communication of sensation happens very frequently in the nerves of touch. Almost every violent pain extends apparently from the region of the affected part, from one tooth to the entire half of the face, from the eye to the frontal, temporal and zygomatic regions, from one finger to the arm, indeed, to the neck, throat and shoulder. Where the predisposition already exists, neuralgic attacks are produced by rubbing or touching the skin, by shaving, &c. Sensitive nerves, specifically different, and especially those lying contiguous, also transfer their excitement to each other. Strong light occasions tickling in the nose, a shrill, disagreeable sound occasions pain in the teeth, and also formication and feelings of cold and warmth in the epidermis. Communication from the nerves of sight and hearing to those of feeling is very frequent; the reverse happens more seldom; still, to this kind perhaps belongs a sympathy, which I have occasion to notice in myself. I can, namely, produce an obscure, subjective sound, nearly resembling the rustling of a dry bladder, if I rub very softly over the zygoma along the outer edge, and the outer half of the orbit and the adjacent surface. The sound originates, perhaps, from communication between the nerves of sight (branches of the trigeminus), and the acoustic; still, it might also depend upon a trembling contraction of the stapedius muscle, and would then belong among the reflected motions. Sensations of taste are also excited by the nerves of touch of the head. I remember to have had, once at the moment of a violent blow upon the supra-orbital region, not only the sensation of a lightning-stroke in the eye, but also a peculiar saltish taste upon the tongue, exactly resembling the taste produced by galvanizing the tongue with a copper and silver coin. Dr. Bruch has repeatedly made a similar experience in reference to the nerves of smell, inasmuch as from an unexpected and violent blow upon the head, for instance, from a fencing rapier, he experienced a sensation as if the nose was filled with dust.

The sympathy between the epigastrium and the vertebral region, which we have occasion to observe in the spinal irritation so much spoken of in modern time (*neuralgia dorso-intercostalis*), may be adduced in proof of the manner in which remote parts of the body enter in consensus by the interposition of the central organ. Pressure upon the affected vertebral region is not always necessary, but often superficial irritations of the skin of the back, compression of a fold of the same, embrocations, leech-bites, pricks of needles, &c., are sufficient to produce painful sensation in the extremities of the intercostal branches of nerves, whose dorsal branches are irritated. Another fact belonging here, is, the itching in the neck, and the irritation to cough caused by pressure upon the region of the processus mastoideus, or by boring in the meatus auditorius externus, and in the same manner, inversely, the itching in the ear in catarrh of the mucous membrane of the larynx, is explicable from the contiguous origin of the ramus auricularis, and the laryngeal branches of the nervus vagus.

Sympathetic motions originate from communication of excitement in an anterior cord of the spinal marrow. They are very frequent and familiar in the voluntarily intended motions of voluntarily movable muscles. We need only be reminded of the difficulty of flexing or extending single fingers, of using single muscles of the face, and of the general muscular contractions which accompany the voluntary efforts of single groups. The doubts to which I alluded in the symmetrical sympathetic motions, prevail here also, and are obviated in the same way, because the here-mentioned form of sympathetic motions also happens in the voluntary muscles whose nerves are deprived of the influence of the will by hemiplegia. Bell has the following observation communicated by Abercrombie:—A man attacked with hemiplegia was completely paralysed on the left side. No motion of this side was manifested except under the following circumstances:—he was very frequently obliged to yawn, and, as often as he did so, the paralysed arm was firmly elevated until, in the horizontal position of the patient, it was raised to a right angle with his body; the arm rose continually during the

inspiration, and fell down again at the beginning of the expiration, apparently by its own weight. Kurschner reports an exactly similar case. The above-mentioned hemiplegic patient, examined by Marshall Hall, drew the paralysed leg upwards involuntarily, whenever he coughed. In another, yawning and sneezing moved the paralysed limbs,—yawning particularly the arm, sneezing particularly the leg. In a hemiplegically paralysed patient, whom Holland treated, the fingers of the right hand, when he gaped, were suddenly extended, although at other times they were flexed close and firm, without the patient being able to open them voluntarily. Many spasmodic diseases, such as strabismus, stammering, cramp of the hand among writers, &c., depend upon an abnormally increased inclination to sympathetic motion; and if in these affections and in the contractions of many muscular groups, the dividing of a single muscle restores the normal tone to all the rest (as, for example, in a case of Stromeyer, where division of the sterno-cleido-mastoideus muscle cured torticollis, and with it also stopped the accompanying spasm of the muscles of the face and eyes), then we cannot question the influence of the contraction of one muscle upon the contractility of those contiguous to it.

The constant plexus formations in the nerves of the external parts of the body teach, that nature intended to have the filaments arranged differently in the central organs from those in the peripheric parts. This becomes intelligible, if we suppose that the muscles do not most frequently co-operate exactly in the order in which they are peripherically contiguous; and if we therefore assume, that in the branches the filaments are connected for anatomical purposes, in the roots they are connected according to the necessity of association. Perhaps we might explain the peculiar origin of the nervus accessorius, if we consider it, with Bernard, as the pneumogastric nerve, from the fact that the roots of this nerve and of the nervus phrenicus, whose functions are peculiarly combined in the formation of the voice, proceed in company a certain distance through the spinal marrow.

The association at one time of the whole extensors, at another

of the flexor muscles, in tetanic spasms, renders it probable, that in the higher parts of the central organ, the nerves of the extensor and of the flexor sides of the body approach each other.

3. *Communication in thickness of the Spinal Marrow.*—This takes place equally well from the anterior cords to the posterior, as from the posterior to the anterior.

First. *Communication from the anterior cords to the posterior*, from motor to sensitive nerves (reflex sensation of Stromeyer).—The connexion of spasm and neuralgia, or, to speak more generally, of spasm and excitement of the neighboring nerves of sensation, is very common. We may mention the violent pains in spasmodic closure of the sphincter ani (fissura ani, Boyer), the pain in the knees in contraction of the muscles of the hip and pelvis, the pain in the neck and occiput in contraction of the sterno-cleido-mastoideus muscle; further, the photophobia, from which, according to Bohm's declaration, the majority of strabismus patients suffer. If here also we may not be met by the objection, that the excitement of sensitive and motor nerves may be the simultaneous effect of the same external or internal cause, then at least both the following series of facts establish the possibility of the secondary participation of the sensitive nerves in the excitement of the motor:—First, the neuralgia which accompanies contractions, is increased by augmented tension in the muscles concerned, and indeed equally well by active as by passive tension, although the latter even is impossible without active counteraction and resistance of the muscle to be extended. Simple neuralgia is augmented, or the attack is excited by voluntary motions of the contiguous muscle; for example, the facial pains by chewing, speaking, swallowing, &c., ischiatic pains by walking, spinal pain by coughing, and other exertions. And even in the healthy nerves of sensation, violent and long-continued motions excite pain. I speak not of the pain of fatigue, whose seat more probably should be sought in the muscles themselves, but of the characteristic pains of contiguous parts; of intercostal pains (stitches in the side) after run-

ning; of tickling and scraping in the throat, after too long continued speaking or singing. Second, tenotomy, and, in fissura ani, division of the sphincter muscle stops the pains, and after dividing the muscles of the eye, with its normal position returns also its ability to endure the light. Still more! After the division of a muscle in a state of contraction or disposed to abnormal sympathetic motion, even after the accidental laceration of a healthy muscle, the skin, which covers it often in the whole extent of one limb, becomes benumbed, or feels like fur; and the more vigorous the muscle, the more certainly and more strikingly does it become so. This condition does not always appear immediately, but often not until a quarter of an hour or later after the division; then is diminished the next day, but continues in greater or less degree until the divided ends are again healed over, and then goes off with the feeling of formication. During this condition, diagnosis, with regard to the extent of the irritated points, is not more obscure than in sound limbs, only it needs a stronger impression.

Second. *Communication from the posterior cords to the anterior, from the nerves of sensation to the nerves of motion.*—These are the so-called reflex motions, the most familiar and the most extensive sympathies, and at the same time the most instructive, because they may be artificially obtained, multiplied, and modified, by way of experiment.

Among these sympathetic motions there are some which always ensue, even in the normal condition, indeed, are the condition of health: to these belong particularly the contractions of involuntary muscles, for instance, of the iris, from irritation of the optic nerves; the contractions of the muscles of respiration, sneezing from irritation of the nose, coughing from irritation of the glottis; and usually also of the ramus auricularis nervi vagi, in the meatus auditorius externus. Likewise in those muscles which are altogether voluntary, reflex motion is equally sure to follow certain irritations; for example, the contractions of the perineal muscles, when the uretbra is filled with fluid; of the eyelids, when the conjunctiva is touched. But usually reflex motions in the voluntary muscular system happen only in abnormal conditions, as in narcosis,

after decapitation, &c. It is interesting to observe the relations in which determinate nerves of sensation stand to determinate motor nerves, so that irritation of the former constantly produces reflex motions of the latter. Romberg calls attention to the fact, that in regions lying contiguous to each other, sensitive irritation manifests a different reflex effect, that cough results from irritation of the vagus in the glottis, deglutition from irritation of the vagus in the pharynx, choking from irritation of the glosso-pharyngeus in the roots of the tongue; irritation of the vagus lower down in the œsophagus, or in the lungs, by inspiration of cold air, seems to occasion spasm of the diaphragm, hiccough, &c. Reflected motions after decapitation manifest themselves first of all in the irritated extremities, and the body of the beheaded snake is writhed towards the irritated side. In the mammalia recently killed, the eyelids close after irritation of the conjunctiva, the lips and other facial muscles move from touching their external skin, or from pulling the hair of the beard; the tongue trembles if its mucous membrane is slightly touched; the muscles of the larynx are convulsed, if its mucous membrane is rubbed; pinching of the peritoneum produces convulsions of the abdominal muscles. In strangulated dogs, the bulbo-cavernosus and ischio-cavernosus muscles contract at every irritation of the turgescent testicles. Even in sleep reflex motion may be directly excited in the irritated spot by tickling, for instance, in the nostrils and the corners of the mouth, by tickling the mucous membrane of the nose and the lips, in one leg by titillating the sole of the foot, &c. The consensus between the nerves of sensation and motion of the same region becomes still more striking in many local diseases and wounds of the nerves. Swan relates that a young man, after a stab in the vicinity of the knee, which hit the saphenus nerve, experienced a continual trembling of the thigh and leg. Brodie treated an hysteric patient, who suffered from attacks of cramp in the chest, which were always excited by slight pressure upon a limited spot of the skin in the region of the processus ensiformis. In neuralgia of the face, clonic spasms of the facial muscles are frequent, and also in ischias, cramp and convulsion of the lower extremities happen. They are ex-

cited by getting into bed or out of the bath, or even of their own accord during the attack. Contractions of muscles in the vicinity of inflamed joints, are familiar to every physician.

From the motor nerves, which stand in the most intimate connexion with the irritated sensitive nerves, the reaction, under certain circumstances, is further diffused over the motor system. Strong light excites not merely contraction of the pupils, but also sneezing, even vomiting. In an apoplectic, who was insensible to any other irritant, the sudden falling of the sunlight on his eyes excited violent spasms of the whole body. From irritation of the Schneiderian membrane first results contraction of the pupils, then sneezing. From excitement of the nervus acousticus, by violent, loud sound, first follows probably contraction of the small muscles of the ear, then also of the iris, frequently palpitation of the heart, and shrinking of the entire body. Vomiting often accompanies the choking from irritation of the roots of the tongue, and the coughing from irritation of the glottis. Irritation of the mucous membrane of the urethra first causes contractions of the muscles of the perinæum, then convulsive motions of the lower extremities, in fact, of the entire body (the shuddering in urinating), which, during the coitus, may amount to true epileptic spasms. From every local irritation, finally, general spasms may proceed ; sometimes of the respiratory muscles, sometimes of the entire voluntary muscular apparatus ; and thus St. Vitus's Dance, epilepsy, tetanus, originate from a limited inflammation of the nerves, or from compression or laceration of them. Mitchell saw spasm of the face from irritation of the dental nerves by caries; frequently, also, spasm of the cervical muscles, and even of the upper dorsal muscles. Swan saw, after a wound of the thumb, spasms—sometimes only in the arm of the affected side, sometimes in both sides, most frequently in the entire upper half of the body, and seldom in the lower extremities. Many similar examples are found in Marshall Hall's "Lectures on the Nervous System and its Diseases," Lond. 1836; and "Memoirs on the Nervous System," Lond. 1837, p. 24; and also in Brodie.

After having discussed and explained the different directions

in which excitement progresses, it now remains to ascertain whether the structure of the central organs pre-eminently favors communication in the one or other dimension. This point is chiefly decided by experiments with reflex motions. Volkmann saw, that by gradually-augmented irritation of the toes of a frog, first the foot, then the entire limb were moved; then, at the same time, the homonymous limb of the other side, and, at last, all the extremities. Thence he concludes, that communication in the dimension of length of the spinal marrow takes place easier than horizontally, as actually the first and third root of the plexus lumbalis of one side lie farther from each other than the corresponding roots of both sides; and yet an irritation of the toes of one side is communicated more readily to the thigh of the same side, than to the toes of the other side. The same thing is seen in the communication of sensation, because pain from one point much more commonly spreads over an entire extremity, than to the corresponding point of the other extremity. Perhaps this depends upon the arrangement of the gray substance in the spinal marrow, which forms proportionately only a small commissure between both lateral halves.

B. ANTAGONISM.

If a point of the epidermis be irritated, the pain, together with the objective perceptible results of irritation, congestion, and inflammation, is spread over a greater or lesser part of the surrounding region. This expansion is *synergetic.* If, therefore, in the vicinity of an inflamed spot, new inflammation is excited, the former is thereby augmented *sympathetically.* But if an *irritant,* which causes congestion or inflammation, is added at a proper distance from the affected part, the excitement in this is thereby diminished, and depression results by antagonism. In a definite circumference, increased excitement is communicated according to the strength of the irritation and irritability; but as, in general, excitability is temporarily exhausted by irritation, and so much the more rapidly the greater the part of the body irritated, so also in extent, the augmentation of irritation in one part occasions diminution of the same in another. This antago-

nistic relation is determined by the same anatomical connexion as the synergetic. The antagonistic effect is therefore first and most usually extended to the parts adjacent. Hence we should infer, at least, that an irritation antagonistic to the therapeutic design we have in view, is so much the more effective, the nearer the antagonistic and derivative irritation is applied to the diseased point, if only not so near as to occasion synergetic irritation. Such phenomena were deemed explicable by a direct propagation or conduction through the peripheric tissues, namely, the vessels; but, aside from the fact, that such a propagation is inexplicable as yet, and is not a matter of course, an artificially produced antagonism between the walls of the body and the viscera lying under them, is not conceivable, even where a serous sac divides both.

In many cases, the change of nervous function, obtained by antagonism, may escape observation. But it is perceptible in the functions of the retina. The complementary colors, as is well known, correspond to the contrasting conditions of excitement of the eye. By the brightest light, namely, the spot of the retina infringed upon becomes absolutely paralysed for a shorter or longer period. Colored light, on the contrary, exhausts it only for the reaction in the one color perceived, and, at the same time, the excitability for the other colors of the spectrum is increased; in fact, the colors are produced independently in the spectrum. The eye, irritated by red, has a green spectrum; that irritated by yellow, a violet, &c., &c. As a rule, the alternate sensations which take place successively in the same nerve, are also intimately associated in neighboring parts of the retina. In the circumference of a surface illuminated red, the eye perceives green; in the circumference of one illuminated yellow, violet; and a small, bright-colored spot in a white surface, may cause the entire remaining field of vision to react in the complementary color.

The anterior and posterior cords of the medulla spinalis furnish, in their reciprocal relations, the most striking examples of antagonism. Irritation of one spot of the skin *synergetically* causes reflected spasms in corresponding muscles. Spasms

arising originally from internal causes, on the other hand, may be cured by irritation of the corresponding nerves of sensation; every one knows how to relieve painful cramp of the gastrocnemii muscles by rubbing the skin. Continuous tonic cramps of the arm are instantly relieved by gentle passes over the skin. To reflex sensation where spasm produces pain, may be compared as corresponding antagonistic phenomena, the cases where muscular activity depresses the excitement of sensibility. Balleir adduces an observation of this kind, certainly an unfrequent exception to the rule: attacks of ischias were relieved by violent motions of the affected limb. We voluntarily seek, often with effect, to mitigate by motion the disagreeable sensation of painful, and particularly of itching parts. Shrieking, gnashing the teeth, wringing the hands, &c., help to endure pain easier. Hysteric people, and even epileptics, long for their attacks, and often endeavor to bring them on, because they consider it as a crisis of many disagreeable sensations wandering about the body.

Antagonism in the central organs may explain, why so frequently in nervous diseases affections of different organs alternate with each other, so that the one becomes, as it were, a remedy for the other, or one morbific influence seems to jump from one place to another; the excitement of one part is transferred to another, but the second excitement is at the same time the cause of the first's ceasing. Alternation takes place most frequently between nerves which, by their position, are consensually connected. Holland saw a case of megrim, repeated nearly every fourteenth day, which regularly alternated between both sides for almost a year, so that the patient could determine beforehand with certainty which half of the forehead would be affected in the next attack. According to Darwin, megrim alternates with odontalgia, when this originates from caries of a tooth. Comparetti observed alternation between pains of the right hypochondrium and of the left shoulder. Reil has collected many cases of this kind. I mention, by way of example, alternation of epilepsy with continuous cramp of the flexor muscles of the right hand, of epilepsy with spasmodic cough, &c. Reil asserts also that, if single convulsively-moved parts are confined down, or

those convulsively bent be straightened by force, that spasms arise in other hitherto free or little-affected parts. The secondary spasms in this case can indeed also be explained by saying that the forcible stretching of contracted limbs, and the binding them down, operates like a new irritant; with the limb bound, it is the same as if, with every motion, it pushed against a foreign body. But it seems as if the cure of pains and spasms by means of section of the nerve, might give occasion to a transference, or so-called metastasis, to other nerves. Mounsey mentions such a case. The patient suffered with continual pains in the thumbs, to which were sometimes added trismus and asthma; after the nerves of the thumbs were divided, the spasms in the face and neck increased. Tenotomists speak of metastases of strabismus from the eye operated on to the previously sound eye; although Bohm has given another, and, it appears to me, a more natural, explanation of this phenomenon.

II. SYMPATHIES OF THE SPLANCHNIC NERVES.*

A. SYNERGY.

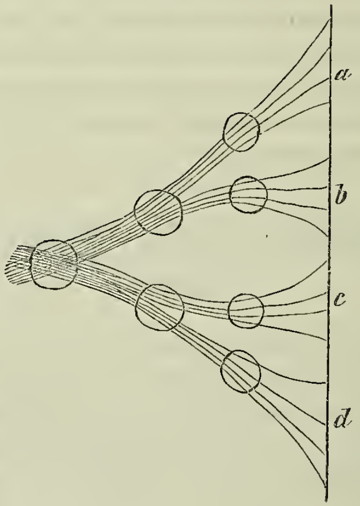
Anatomico-physiological investigations have led to the opinion that the splanchnic nerves terminate partly in the ganglia, partly —and in the mammalia, indeed, for the most part—they enter the spinal marrow through the ganglia, although they usually run a certain distance upwards, seldom downwards, in the sympathetic, in order to unite with a nervous trunk of the spinal marrow lying higher up, very seldom with a lower one. It remains undecided whether the motor nerves of the viscera pass into the brain or not; but in regard to the sensitive nerves I have thought it necessary to maintain this transit.

If this statement is correct, and the gray substance of the

* "*Eingeweide-nerven*" is here used in a general sense, including, as I understand the author, all the nerves of the viscera, or, rather, the particular nervous filaments of the viscera. The term "splanchnic nerves," with which I have translated it, must receive, therefore, the same general signification, and is not used, as in our Anatomies, to designate merely two branches of the sympathetic, but their continuation and distribution to each of the viscera.—TRANS.

ganglia, like that of the brain and medulla spinalis, is continuous, then, through the ganglia occurring in and on the organs, must smaller tracts of the viscera,—through the more remote and larger ganglia, in which many nerves enter, larger tracts,—finally, through the spinal marrow, must the entire tract of the viscera, and even the viscera themselves, be brought into sympathy with the external parts of the body. Accordingly, we may represent the structure of the splanchnic nerves by the following figure. A pair of filaments, motor, or sensitive and

Fig. 4.



motor, which come from a part *a* of an organ, for instance, the intestine, are grasped together, and, at the place where they meet, are surrounded by gray substance, and therefore are brought into continuous connexion, so that irritation of a sensitive filament at the point *a* passes over, under certain circumstances, from *a* upon all the motor filaments. A second fasciculus comes from the point *b*, and conducts itself in a similar manner, a third from *c*, *d*, &c. After the filaments from *a* and *b*, from *c* and *d*, each bundle has pierced through its own ganglion, they are again isolated, they continue to propagate their excitement towards

the central organ, in the same manner that animal filaments in the spinal marrow occasion reflex motions, and yet, in the brain, sensation. But, on the way to the central organ, *a* and *b*, *c* and *d*, become again surrounded by gray substance of ganglia of a second order, and thus the irritation of a sensitive filament *a* becomes farther transmitted also to the motor filaments of *b*. Still farther on, *a*, *b*, *c*, and *d*, come again into conductive connexion through the gray substance, and in the *ganglion cœliacum* all the nerves of motion of the intestine seem to meet, as irritation of this ganglion occasions motion throughout their whole extent. Finally, the filaments issuing from the ganglia enter the spinal marrow, and this is the ganglion which accomplishes the communication between all the organic filaments of the abdomen, chest, and head. For this reason, irritation of the medulla spinalis affects all the organic nerves, irritation of a principa ganglion (*cervicale primum*, *cœliacum*) the organic nerves of an entire cavity, and irritation of the smaller ganglia which are nearer to the organ produces slighter and more limited effects.

The results of experiments with reflex motions coincides with this construction. I have observed, that in mammalia and frogs, the annular contraction, which follows superficial irritation of a limited region of the intestine, was confined to very limited tracts, if the bowel was cut off close to the mesentery. On the contrary, that it was extended, as if peristaltically, to the neighboring parts, if the connexion of the nerves of the intestine with the ganglia remained undisturbed after destruction of the brain and spinal marrow; and, lastly, that the most extensive peristaltic motions were produced, when the gut of a recently-killed and irritable animal was locally irritated in the uninjured central organs. If exsected organs respond to a partial irritation by motions throughout their whole extent, especially by regular motions, then the conducting ganglia must be included in the substance of the organs, as is demonstrated of the heart, and is rendered particularly apparent by Volkmann's experiment, according to which, longitudinal division of the heart, continued beyond a certain point, destroys the synchronism, and, under certain circumstances, the transmission of irritation from

one half to the other. If the œsophagus be cut off under the diaphragm, and the viscera, with the ganglion cœliacum, be taken out, the irritant operates, in the stomach of the mammalia, only upon the spot irritated, and spreads no further; a proof, that the substance which interposes conduction between the sensitive and motor nerves, and thereby causes the extension of motion, lies not in the stomach, nor in the ganglion cœliacum, and is to be sought either in the ganglia lying higher or in the spinal marrow.*

The presence of a medulla spinalis, in frogs even of the medulla oblongata, is necessary, in order to excite motions of the

* I must here be content simply to demonstrate, how in general the reflection and extension of reaction is accomplished in the system of the splanchnic nerves. A mechanism is not yet to be found, yea, hardly to be sought, which renders intelligible the one-sided progression of the regular peristaltic motion, and the antagonism between individual parts, e. g., the auricles and ventricles of the heart. Meanwhile, we should consider the central organs, including the ganglia, as the appropriate regulators of this relation, if, as Volkmann asserts, continuous irritation, by means of the magneto-electrical apparatus, is unable to produce continued spasm, in case the nerves, upon which it is applied, still penetrate masses of ganglia between the place of irritation and the peripheric extremity. According to Volkmann, it occasions motion even then (which Budge contradicts), but only the regular, peristaltic, or rhythmical motions, whilst the nerves without ganglia, being subjected to a continuous galvanic current, excite tonic spasms in their muscles. However, one cause, as well of the progress of motion in a certain sense as of antagonism, might exist in the peripheric arrangement of the nervous and muscular filaments of an organ. This conjecture is supported by the remarkable experiments of Kempen (*Essai Expérimental sur la Nature Fonctionelle du Nerf Pneumogastrique: Louvain*, 1842, p. 60), concerning the influence of the nervus vagus upon the motion of the œsophagus. It was shown, namely, that in the rule the œsophagus was contracted from above downwards peristaltically, when the vagus was irritated, no matter whether in the origin or in the neck. Only once, by irritation of the trunk in the neck, a violent contraction of the œsophagus ensued, which drove the contents of the same back into the throat. The cause of this exception, Kempen could not discover. But here no ganglia lie between the irritated part of the nerve and its termination in the muscles. And Volkmann likewise noticed only tonic, no rhythmical motions in the œsophagus, upon application of the magneto-electric current. How the structural relations of the muscles could occasion the peculiar mode of contraction of the tubuliform intestines, and of the heart, Kürschner particularly has attempted to explain: to whom I would refer the student.

external parts of the body by irritation of the viscera, as Pickford found by experiment, and Valentin corroborates it. After removal of the medulla oblongata, reflected spasms of the lower extremities may be produced only from the rectum and bladder; and therefore the nerves of the remaining viscera appear to meet with the other nerves of the body first in the medulla oblongata; that is to say, they penetrate the medulla oblongata. Moreover, after decapitation, we succeed in producing convulsions in the voluntary muscles, by irritation of the viscera, much more readily in frogs than in mammalia. Reflected motions in the mammalia are common only after irritation of the connecting branches of the sympathetic with the spinal nerves.

Reflex motions and reflex sensations, from sympathies of the splanchnic nerves among each other, are principally apparent in pathological and physiological events. To reflex sensations we may attribute the pains which accompany spasm of the large intestines (colic), and contractions of the uterus. Reflex motions, as in external parts, appear immediately under the irritated membranous regions, as well from irritation of serous as of mucous membranes, and, indeed, as I believe I have before. remarked, more readily in the first than in the second case Still, single regions of the mucous membranes also stand in relation with very remote muscles. Where there are worms in the intestinal canal, the pupils are dilated in consequence of irritation of the sympathetic root of the ganglion ophthalmicum. According to Valentin, irritation of the penis is followed sometimes by peristaltic motions of the vesiculæ seminales and the vas deferens; friction of the vaginal mucous membrane very frequently by peristaltic motion of the Fallopian tubes. The use of the tampon assists in exciting contractions of the uterus, when procuring artificial abortion.

In the relation of the visceral nerves to the external nerves of the body, there is, first, as I have already mentioned in passing, a sympathy established between the walls of the cavities of the body and the organs contained in them. It exists not merely between the skin of the cranium and the brain, between the skin of the neck and the larynx—where a vascular connexion

might be conjectured—but also between the thoracic walls and the lungs, the abdominal walls and the abdominal viscera. Cold or warmth, or any other irritation of those external regions, operates immediately, either injuriously or healthily, upon the viscera situated beneath. Sympathetic and so-called metastatic inflammations, which are very frequent in wandering erysipelas, are very apt to occur in the serous membranes corresponding to the cutaneous regions attacked. On the other hand, according to Rademacher, in painful diseases of the liver, the abdominal muscular fibres of the right side are in continual spasmodic tension.

If we go into a more exact definition of locality, then a consensus is presented between the bowels and parts of the trunk situated higher up, that is, with organs in which the cerebro-spinal nerve is expanded, to which the nerves of the viscera are united on their way to the medulla spinalis.

Sympathetic Sensations.—No sympathy is so frequently observed as that between the head and stomach. Saburral conditions and other diseases of the stomach occasion vertigo, but most commonly pain in the supraorbital branches of the *trigeminus*, upon one or both sides. The same relation is seen a step lower, if I may use the expression, between the liver and the right shoulder, between the spleen and the left shoulder. In one case of stricture of the œsophagus, every attempt at deglutition excited acute pain in the little finger of the left hand. Itching of the nose from the irritation of worms in the intestines seems also to be referred to this principle. Spinal irritation furnishes the most abundant proofs of our proposition. According to Cruveilhier, cardialgia, when it reaches a certain degree of intensity, is connected with a more or less violent pain in the region of the fourth dorsal vertebra; he observed the same in abscess and in cancer of the stomach. In liver-colic, the painful spot is noticed at the eighth or ninth dorsal vertebra. In nervous diseases of the heart, the pain in the back occupies the fourth or fifth dorsal vertebra; in diseases of the uterus, the second or third lumbar vertebra. In lung diseases, according to Swan, pains occur frequently in the neck. The pelvic organs, the bladder,

rectum, testicles, &c., form an apparent exception, because the pains of the lumbar and sacral nerves sympathetically excited by diseases of these organs, are first perceived in the peripheric ends, in the lower extremities as far as the toes. A woman, who suffered from internal hemorrhoids, experienced pains in the left malleolus, which extended to the sole of the foot and the little toe, every time that the tumors were protruded at stool. A sensation of heat in the lower extremities, according to Bell, is often caused by purgatives; one patient experienced this sensation, with a sensitiveness to external pressure, at every accumulation of irritating matter in the intestinal canal.

In most of the cases where external nerves partake of the condition of excitement of the internal part, the pains in those nerves are the predominant symptom, while in reference to the locality and quality of the latter, the consciousness is less definite. For the same cause also, inversely, is communication from the spinal nerves to the sympathetic less frequent, still also not unheard of, and it follows according to the same laws. External pressure upon the retina, straining to see an object close at hand, which is always accompanied with compression of the ball by the muscles of the eye, causes nausea and even vomiting. Bell witnessed a neuralgia of the temporal region which was connected with a sensation in the stomach, "as if it contained something alive within it."

As an example of consensus between the nerves of the viscera, and the deeper peripheric nerves, I mention the itching in the glans penis in cases of urinary calculi, or in the anus in case of worms. Upon a sympathetic sensation within the domain of the splanchnic nerves depends the pain in the testicle of that side whose ureter is irritated by the descent of a kidney-stone into the bladder.

Sympathetic Motions.—The involuntary muscles very frequently sympathize, when the voluntary muscles, especially if they are in proximity, are excited by internal impulses. Thus the iris contracts at the same time with the muscles of the eye, which voluntarily turn the eye inward, and adjust it to the distance, and, what should be particularly noticed, even the adjustment of

one eyeball, or the voluntary squinting of one eye inwardly, causes the iris of both eyes to contract, a sympathy whose foundation cannot well be sought elsewhere than in the cerebral origin of the motor nerves of the iris. The sympathetic contractions of the abdominal viscera during a fit of laughter, whereby involuntary emission of urine or flatus ensues, the sympathetic vomiting during a fit of coughing, are very generally known. The muscles of the bladder, uterus, vesiculæ seminales and intestine are excited to increased activity by the voluntary contractions of the abdominal and pelvic muscles, therefore the peristaltic contractions of the intestine, as well as the pains of labor, occasion motions of the lower extremities, and the exertion to overcome a violent pressure to stool or urine is doubly difficult, if the person restrained thereby attempts to walk. Very properly, methinks, has Müller referred the palpitations of the heart during bodily exertions to *sympathetic* motion. Upon the same principle I have explained the contraction of the bronchia, and the difficulty of respiration arising therefrom, in climbing a hill and other straining motions, yea, even from the thought of such motions; further, the excitement of spasm of the throat, *globus hystericus*, from the continued activity of the fingers in knitting, playing on the piano, &c. The following case communicated by Swan, proves this sympathy between the nerves of the upper extremities, and those of the throat and stomach: A lady, in consequence of an injury of the right shoulder, fracture of the *condylus scapulæ*, complained of pains which extended to the nape of the neck and the fingers. The forearm and hand were nearly paralysed. Every motion of the shoulder excited pain, and caused eructation from the stomach for a long time.

It is not decided, whether, in the excitement of the involuntary muscles, abstracted from the peristaltic propagation of contractions, other muscles, voluntarily or involuntarily movable, participate involuntarily, because the contractions of the uterus, the bladder, even of the vesiculæ seminales, which sometimes appear in the act of defecation, may be occasioned by the contractions of the abdominal muscles and the apparently involuntary contractions of the abdominal muscles in spasms of the bowels, parturition, tenesmus, and other affections, may be reflex mo-

tions proceeding from nerves of sensation. It is an interesting fact, that among paraplegic patients, convulsive contractions of the paralysed limbs appear with the evacuation of the intestine or bladder, as was noticed by Budd in many cases. In a sailor, who received a blow upon the spine, the motion of the lower extremities was lost, whilst sensation remained. The legs were in constant contraction, now flexed, now extended. Every contact caused convulsions; each evacuation of urine was accompanied by convulsions of the legs. Another patient, not completely paraplegic, had spasms in the lower extremities at every stool and urination; in a young woman, in whom both arms and one leg were partially paralysed, the spasmodic sympathetic motions, under the same circumstances, usually appeared only in the leg, once only also in the arms.

Reflex Sensations.—I hardly know of one undoubted example of reflex sensations between internal motor and external sensitive, or between external motor and internal sensitive nerves. A case of Comparetti's, which I have before mentioned, might here be adduced,—where pain in the right hypochondrium, in liver disease, was aggravated by strong and continued motion of the arm,—if it were certain that the seat of the pain was in the liver, and not at all in the epigastrium; the above-mentioned pains in parturition might be considered perhaps as reflected external sensations, especially when they extended to the lower extremities; still, a mechanical influence of the uterus upon the nervous trunks is here imaginable. With violent palpitation of the heart is sometimes connected a sensation of warmth and a disagreeable heat in the sternal and epigastric region, or even a pain passing through the neck and chest to the arms; but it still seems to me most probable that it belongs to the external parts, and is excited by spasm.

Reflex motions from nerves of the trunk upon internal parts, and *vice versa*, are much more frequent. Together with the coughs, hiccough, and vomiting, occurring every day from affection of the mucous and serous membranes, I mention, as evidence of the peculiar relation between the higher external and deeper internal organs, the strabismus occurring in saburral conditions

and other diseases of the stomach, and from worm-irritation, trismus from irritation of the bowels by worms; so also, inversely, the nausea and vomiting from irritation of the nervus opticus or trigeminus by pressure upon the eye and violent straining to see, megrim from irritation of the ramus auricularis nervi vagi, of the glosso-pharyngeus, and even of the nerves of the chest and arms. Sir Astley Cooper has repeatedly observed vomiting, in neuralgia of the mammary glands. The following case, from Wardrop, shows sympathy between the arm and the stomach. "A lady had stuck a thorn in the right index-finger. She suffered a whole year with nervous attacks, which disappeared after amputation of the finger. During her sickness she had a constant pressure in the stomach, and vomited both food and drink. In these attacks the pain extended up the arm into the neck and head, thence it shot into the stomach, and excited nausea and vomiting." Spasmodic stricture of the bronchia, asthma, is aggravated by the influence of light upon the eye, and becomes mitigated in the dark. Asthmatic attacks which may lead to spasmodic closure of the bronchia, and cause death, are produced by sudden and rapid cooling of the skin, either in large tracts, as by plunging into a cold bath, or even, to a smaller extent, if the irritant meets the face and breast, as by sprinkling this region with cold water. The same means, and likewise rubbing of the skin, manifests its reviving power in syncope and asphyxia, perhaps by virtue of a reflex action upon the heart. Pressure upon a painful vertebra excites many kinds of internal spasm, as globus, constriction of the respiratory organs, vomiting, &c.; but most frequently the spasms proceed in a direction downwards. Upon this point I will only remark, that pressure does not always operate by reflection from the sensitive dorsal branches, but it also operates directly upon the nervous trunks lying in the intervertebral foramina, in which case the internal affections are no phenomena of sympathy, it is true, but are always an index of the course of the splanchnic nerves.

In the visceral region, also, reflected motions become very extensive after violent influences upon the nerves of sensation, or under other favoring circumstances. From the kidneys

and ureters arise hiccough, vomiting, colic; from the uterus, vomiting; from the bladder, erection of the penis; from the stomach and bowels, especially among children, many forms of general spasm.

B. ANTAGONISM.

Irritation and inflammation of the mucous membranes were for a long time described only in connexion with spasm of the corresponding muscular layers. Abercrombie first gave value to another opinion in reference to the intestinal canal, by demonstrating that not spasm, but a paralysis of the intestinal canal, was the cause of ileus (*iliaca passio*), which sometimes appears alone, sometimes in connexion with inflammation of the mucous membrane; in the latter case, the inflammation may be either present from the beginning, or only added to it subsequently. Stokes refers to these facts in order to explain how a dilatation of the bronchia may occur, in and after bronchitis.

Now, if we look at these phenomena alone, there is an antagonism of the mucous and muscular membranes, irritation of the former with paralysis of the latter. But another question arises, whether the internal connexion here is that of antagonism; whether the paralysis is occasioned through the interposition of nerves from the mucous membrane? Abercrombie expresses no conjecture concerning the relation of these two affections to each other. Stokes considers the paralysis as secondary, the result of an exhaustion of the muscular power after its activity has first been sympathetically increased. To me it appears most probable that the same disturbance of the circulation which, on the muco-membranous side, produces the symptoms of inflammation, at the same time directly depresses the tone of the muscles.

A fact, although in a different manner to be considered, yet at all events a very interesting one, is the favorable change which is brought about in chronic diseases of the heart by paralysis of the external parts of the body;—a fact to which Holland has more than once referred. A patient, for the space of fourteen years, had a pulse of seldom less than one hundred and twenty beats in a minute, a hardly perceptible beat of the heart,

and cold extremities disposed to œdema. After a slight attack of paralysis, the pulse diminished in frequency, sinking to seventy and eighty; at the same time the pulse became stronger, and the body grew warm.

In neuralgia of the trigeminus, a morbid dilatation of the pupils (*mydriasis*) is frequently present. If this depends upon paralysis of the associated filaments whose nerves spring from the oculo-motorius, then it deserves the name of an antagonistic affection; but the dilatation of the pupils may also be active, and proceed from irritation of the sympathetic root of the *ganglion ciliare;* it would then owe its origin to a synergy between this root and the sensitive filaments of the *nervus trigeminus.*

Amblyopia and amaurosis occurring in diseases of the stomach and intestinal canal, furnish rather a doubtful example of antagonism between the eye and the abdominal organs. Tiedemann has collected many ancient observations of permanent and of periodic blindness occurring in persons afflicted with abdominal diseases; but neither the form of the abdominal affection nor the proximate cause of the blindness are sufficiently characterized to warrant a conclusion therefrom. Perhaps the faculty of vision was sometimes only disturbed by spasm of the muscles of the eye, as in the case of Bell, where the upper eyelid hung down, and the eyeball was rolled upwardly to such an extent as entirely to conceal the pupil.

Continual suppression and retention of the urine from inactivity of the muscles of the rectum and bladder, together with hysteric tympanitis, is a very common symptom among the spasms and neuralgias of external parts.

The cases of alternation between external and sympathetic nerves are more reliable; for instance, pain in the face and cardialgia frequently alternate with each other. I quote the following observation from Balleir: A young man, who had a predisposition to facial neuralgia, was attacked with lancinating pains in the right temporal bone, which extended also to the opposite side. One evening, as he had a very red face, some one applied cold compresses to the forehead; in about five minutes

the headache began to relent, and three or four minutes afterward entirely vanished. But at the same time a sensation of pressure in the epigastrium appeared, which suddenly increased and changed into torturing pain, with danger of suffocation, painful vomiturition and distressing nausea. The attack lasted from one to two hours. A few months before he had suffered an exactly similar attack. W. Arnold has observed alternation between lung diseases, and an eruption on and behind the ear.

III. SYMPATHIES OF THE CELLULAR TISSUE.

The conditions of the cellular tissue are made known only by changes, and in fact involuntary changes of the tone; here we naturally speak only of the contractile cellular tissue of the skin, the tunica dartos and corpora cavernosa, and of the nipples. Their sympathies therefore are limited, like those of the vessels, to sympathetic motions, reflex motions, and perhaps antagonistic paralyses.

As the iris is associated with motions of the muscles of the eyes, so is the tunica dartos associated with the motions of the muscles of the perinæum, and even of the lower extremities. Strong contraction of the sphincters of the anus and bladder, for the purpose of resisting an urgent inclination to evacuate, also result in contraction of the scrotum. The same takes place in continued marching, particularly so in climbing up hill, also when the body is heated and perspiring.

Spasm of the skin, *cutis anserina*, is reflected by disagreeable sounds, by scratching upon glass, silk, &c., and by cold, as must be confessed at least in the case where local application of the same produces a general contraction. Rapid warming of the skin also, for instance, entering a warm bath, may occasion at the first instant the same phenomenon. Writers upon spinal irritation make mention of attacks simulating fever and ague which sometimes originate from pressure upon the sensitive vertebræ; but they do not expressly state that these shiverings are connected with contraction of the skin. In a case reported by Stilling, where the patient experienced the same sensation, no contraction of the skin was observed.

In local irritation of sensitive nerves and local reaction of the cellular tissue, spasm is exhibited on the cutaneous region irritated; thus, the erection of the nipples, and the contraction of the tunica dartos from the tickling of the skin covering them, the partial contraction of the turgescent penis (*chordee*) in gonorrhea, the bristling up of the hair in violent and painful neuralgias of the head. Pouteau relates the case of a man, who, after a fall upon the head, suffered for sixteen years with attacks of most violent pain, and states that on the spot affected the hairs were stiffer and coarser than anywhere else on the head, that they never lay down like the others, and as often as any occasion aggravated the pain the hairs stood upright in the most uncomfortable manner. Höflich observed, in a little boy immediately after death, erection of the penis, drawing up of the testicles, and corrugation of the scrotum upon tickling the sole of the foot, and this contraction of the scrotum too upon the right or left side according as the right or left sole was irritated.

Under the influence of heat, which always acts as an irritant to all the nerves, and in particular to the sensitive nerves, the cellular tissue is stretched and relaxed by long exposure to its influence. This expansion is in no case a directly physical one; it is as little so as the contraction of the same tissue under the influence of cold. If it were so it should also in like manner be perceptible after death: with the same temperature, the filaments should always have the same degree of contraction, and should not exhibit so great differences as follow, slowly or rapidly, after a change of temperature, or after that, beyond a certain degree of temperature, it is subjected to a higher or lower degree. But in what manner heat and cold accomplish these changes of tone, I shall endeavor to explain among the sympathies of the vessels, which act in this respect similar to the cellular tissue, but present more numerous points of support.

IV. SYMPATHIES OF THE VASCULAR NERVES.

The tone of the vessels may be inferred only indirectly, from the resistance which they oppose to the blood driven into them by the heart. If the force of the heart, and the quantity of

blood be considered unchangeable, then each vessel yields the more readily to the wave of blood, and becomes more dilated by the same, the weaker the resistance which its muscular coat opposes. This dilatation is immediately perceived by sight or feeling, in the larger and more superficial vessels; strong pulsation, far from being an evidence of increased vital activity of the artery, proves much rather that its energy is weakened. The dilatation, and indirectly, the capability of resistance of the smaller vessels, may be inferred from the color and turgescence of the tissues in which they are distributed; because the broader the little streams of blood in proportion to the parenchyma, so much the more preponderates the red color of the blood, and the wider the vessel, so much the thinner become its walls, and so much more abundant becomes the exudation through them, which is manifested by the tumefaction or effusion of plasma. By this process, increase of secretion is produced in the glands; in other parts the symptoms of dropsy, of inflammation, and its effects are developed. On the contrary, contraction of the vessels produces paleness of the tissues, collapse, and when this condition is continued for a length of time, atrophy. Under some circumstances the blood accumulates in the capillary veins, if the arteries are contracted, and causes a blue livid color of the skin, which, however, may readily be distinguished from the capillary congestive redness.

With due regard to the force of the heart, and the quantity and quality of the blood, we are therefore enabled to diagnose the condition of excitement of the vascular nerves in individual cases, and as both those relations for all parts of the body are always identical, so the comparison of the color and turgescence of each single part of the body with the color and turgescence of the rest, gives us the measure of excitement actually existing in its vessels.

Now this excitement changes, as well in sensitive as in motor organs, simultaneously with the activity of the latter. It increases or diminishes with it in direct or inverse ratio. Whether this is occasioned by the excitement, or whether in all probability a sympathetic or antagonistic relation is in accordance with its

internal nature and essence, I will investigate after I have first collected together the naked facts, summarily arranged.

A. SYNERGY.

I. WITH MOTOR NERVES.

Most, if not all, muscular contractions, are accompanied by continuous spasm of the vessels. Among the muscular paralyses, so called, in the widest sense of the word, we must accurately distinguish two classes. In both, the influence of the will, or the brain-influence upon the affected muscles, is annihilated or very much restricted; but in the one the influence of the spinal marrow continues, the muscles remain irritable, may even be attacked by spasms, and are permanently extended and tense. This is the condition of contraction, as it is observed in paraplegics, and locally in lead-paralysis, in wry neck, club foot, and other curvatures. In the other class belong paralyses proper, where the influence of the spinal marrow is also destroyed, the connexion of the nerves with the central organs is generally interrupted, and the irritability of the muscle soon becomes extinct.

In both cases, the muscle may be flaccid, or permanently rigid, and its nutrition suffers. The permanently contracted, like the paralysed muscle, diminishes in circumference, becomes pale, fibrous, and, notwithstanding it may be healthy, yet, from being doomed to inactivity, it becomes *atrophic.* So that we must conclude, that the alternation between contraction and dilatation is a necessary requisite for the nutrition and support of the muscles; a conclusion which will receive a still more extended confirmation in the following pages. But in contraction proper, the vascular spasm is not restricted to the muscular branches, but extends also to the trunk and to the vessels of the skin which cover the muscle; thereby at the same time contradicting the opinion, that the pressure of the tensely-extended muscular fibres upon the vessels is the cause of the disturbance of the circulation. If the skin derives one part of its blood from deep-seated vessels, which run up through and between the

muscles, so also it receives still another part from the superficially-running branches, which sometimes will have supplied a sufficient collateral circulation.

Among the symptoms of gradual compression of the spinal marrow, which follow incomplete paralysis of sensation and motion of the lower parts, Ollivier mentions as a tolerably constant one, the dryness of the skin, together with the continual furfuraceous exfoliation of the epidermis. This desquamation, with dryness and paleness, is a sign of impoverished nutrition of the epidermis, and should not be confounded with the exudative peeling off of the same. Heine calls attention to the small and weak pulse in the immovably-bent limbs of paraplegic persons. B. Langenbeck says: "In all parts of the body spasmodically affected, secretion seems essentially changed; by spasm of the muscles of the œsophagus, the mucous membrane of the throat becomes livid and dry; by stammering, the mucous membrane of the tongue; by contraction of the *sphincter ani*, the mucous membrane of the rectum; and icy coldness, together with flaccidity of the whole skin covering them, are the constant accompaniments of any considerable contractions of the sural muscles." Under this head belongs also, according to Baumgarten's observation, the paleness, exsanguination, and dryness of the conjunctiva in strabismus. The tenotomist, with the tension of the muscle, relieves the spasm of the vessels, together with the reflected pains; the intersected muscle regains its extent; the skin covers over the divided sural muscles during the process of healing, or heals by the first intention, with profuse perspirations; intersection of the sphincter ani cures the dryness and fissure of the rectum; division of the muscles of the tongue, the troublesome dryness and cracked condition of the tongue.

In persons who are very cold, or those suffering with ague, in connexion with contraction of the vessels, we sometimes meet with a trembling, or a clumsiness of the muscles, which perhaps we should call partial paralysis rather than spasm. On the other hand, upon the same occasions, and especially if they appear in higher degrees and continuously, we also observe

convulsions, shiverings, &c., which leave no doubt concerning the possibility of a complication of muscular and vascular spasm.

II. WITH SENSITIVE NERVES.

According to Descot, during the paroxysm of tic douloureux, the face is in some cases pale and colorless, but much more frequently, certainly, it is red. Microscopical investigations concerning inflammation teach, that the vessels of the irritated part first contract upon moderate irritation before they dilate. The stage of contraction is short, and may be entirely wanting.

B. ANTAGONISM.

I. OF MOTOR NERVES.

The antagonism between muscles and vessels is readily seen, where the muscular functions exist in healthy proportions, in the fact that the vessels of a part much exercised tumefy, on account of the increased turgescence of the part, and the hypertrophy of the exercised muscles, which is the result of frequent moderate exudations. All the glands in the neighborhood of such muscles secrete abundantly. The perspiratory glands of the skin are stimulated to secretion by motions and by general spasms of the muscles of the trunk; perspiratory glands and salivary glands by the motions of chewing and speaking, even where no direct irritant operates upon the mucous membrane of the mouth. This sympathy may be morbidly augmented, as the following case, related by Holland, demonstrates. In a man about thirty-six years old, and otherwise healthy, from the slightest exertion of speaking, eating, or any emotion of the mind, there broke out a copious perspiration, like drops of rain, upon the right half of the face, exactly bounded by the median line, whilst the left half remained in its natural condition. Similar observations have been made by Giesker, Stannius, and Oesterlen. In the case of Oesterlen, the phenomenon appeared simultaneously with painful excoriations on the inner surface of the cheek; the skin, in a state of perspiration, felt warmer than

the rest, without changing its color. In both the other cases, this sympathy was one of the sequelæ of typhus fever; with that of Stannius, probably the consequence of an abscess of the parotid gland, which was opened during the fever. In both, the skin became red before the irruption of the perspiration. Stannius could also produce the secretion of sweat by rubbing the internal surface of the cheek.

II. OF SENSITIVE NERVES.

a. Augmented Excitement of the Sensitive, with diminished Excitement of the Vascular Nerves.

That any external irritation whatsoever of sensitive nerves, in the skin, in the mucous membranes, or in the deeper-seated parts, causes dilatation and congestion of the small vessels, redness and turgescence, or augmented secretion, is something so constant and so well known, that I might be justified in omitting the enumeration of special examples. Whilst heat, in moderate application, enlivens the sensitive nerves of the skin, it occasions at the same time, by expansion of the vessels, turgescence and diaphoresis; and, if the same irritant be applied intensely, the sensation amounts to a feeling of pain, and thus turgescence passes over into the so-called inflammatory congestion and exudation, and their events. Every other irritation, mechanical or chemical, operates in an entirely similar manner; and the tone of the vessels, under otherwise normal proportions, always stands in an inverse ratio to the excitement of the sensitive nerves. If contraction sometimes precedes the dilatation of the vessels, as was above adduced as the result of microscopic observations, still it is wanting in most cases, and does not always follow from the most violent impressions; and even where it happens, it affects not our argument, because we may, with equal propriety, derive the dilatation from a secondary exhaustion of the vessels.

But the excitement of sensitive nerves, from internal causes, is also followed, very frequently, by paralysis of the vessels, with its consequences, augmented secretion or redness, with more or

less perceptible tumefaction; whereby a complex of symptoms arises very similar to true inflammation.

Flow of saliva and of tears, and a discharge from the nostrils of the affected side, is a very common symptom in attacks of facial neuralgia. In one case (Zechmeister), every paroxysm terminated with profuse lachrymation. After a long duration of the disease, the flow of tears or of saliva became permanent (Romberg). In women, fluor albus is an accompaniment of neuralgias of the abdominal and lumbar regions (Ballier). During a neuralgia of the thumb, after injury of the nerve, the affected finger and the whole hand was covered with perspiration at the mere attempt to touch it. Aronssohn observed, that in consequence of a neuroma on the inner condyle of the humerus (*nervus ulnaris*), the inner surface of the hand was covered with a constant perspiration. In the same patient, a neuralgia of the knee was accompanied with œdematous swelling. Œdema of the scalp, in clavus hystericus, was observed by Enz; œdema of the face, in tic douloureux, also by Brodie.

Almost all who have observed neuralgias, make mention of the simultaneous redness; often, also, of the slight tumefaction of that part of the skin which is painful. Griessinger has collected a great number of more ancient observations. Descot has been quoted already above. So also says Earle, that in all cases of tic douloureux, which he had opportunity to notice, a strikingly augmented flow of blood to the diseased part, with a more or less remarkable increase of heat, took place during each attack of pain. For instance, the conjunctiva almost always appeared injected (Romberg, Ballier). Oesterlen witnessed an intermittent neuralgia of the eye, with injection of the vessels, to such an extent that it had been treated as ophthalmia. In three cases of violent neuralgia following contusion of the scalp, Pouteau noticed, many years after the injury, that the skin was more or less dark red, and slightly swollen. In the case mentioned by Aronssohn also, during the neuralgic attack in the leg, there arose a bluish, very painful tumor, about one inch in diameter, upon the dorsum of the foot, and a second smaller one on the inner margin of the tibia. All the superficial cutaneous veins

of the leg also were swollen. After the attack was over, only a slight sensibility to the touch remained in these places. A very similar and interesting case is communicated by Graves:—A lady had attacks of tickling and heat, amounting to pain, in the feet and as far up as to the calf. In the attack, the skin became red, then blue and tumefied. Regular daily attacks appeared alternately upon both sides. After suffering thus for three years, there was no permanent change of form of the extremities. In the disease which Sir Astley Cooper has described as *irritable breast*, *irritable testicle*, in his work upon "Diseases of the Mamma and Testicle," only a neuralgic affection of these parts occurs primarily. Yet later appears also swelling and redness of the skin over the same. A reddening of the breast, in stripes, happened in a case by Rowland, where neuralgia of the arm and of the mamma had arisen after a wound of the nerves of the hand. Brodie likewise witnessed tumefaction and violent pain from pressure on one testicle, which had been subjected to sympathetic pains for a long time, from the passage of a kidney stone through the ureter. Brodie, in the lectures more than once quoted, concerning local nervous disease, as also before, in his work upon the diseases of the joints, has called attention to a painful affection of the joints, connected with redness and tumefaction, which he confesses to have confounded ofttimes before with inflammation of the joint, but which has its seat in the skin only, and may be a pure nervous, hysteric affection. The redness and swelling in this case stand in the same relation to the pain as in tic douloureux. They have their seat in the skin only, and disappear as soon as the neuralgic attack has passed away. The disease of the joint alternates with other hysteric symptoms, spasms, &c., &c. I will relate only one of many instructive cases of disease, by way of illustration:—A lady suffered from facial neuralgia; the physician prescribed valeriana. The facial pain disappeared, but, almost as soon, pain in the foot commenced, which was repeated every afternoon. After a little time, redness of the skin, and swelling of the parts was added, even as far as the roots of the toes. These symptoms of inflammation increased for several hours, and then subsided entirely.

When I was consulted, these attacks had continued already three months. I gave sulphate of quinine, by which the disease was cured in a few days. When the pain has its seat in the hips, sometimes a general swelling of the leg and the buttock takes place; sometimes, but seldom, the swelling is more circumscribed, nevertheless very different from an abscess. Brodie compares its shape to an urticaria swelling of unusual size. Intermittent fevers, as is well known, are not unfrequently accompanied by local neuralgias; and such neuralgias sometimes assume the external symptoms of a rheumatic inflammation. Hildreth relates the history of a lady who suffered, during an *intermittens quotidiana*, with headache, sensitiveness of the left hypochondrium, and an apparent inflammation of the knee, which was red, swollen, and, particularly during the paroxysm of fever, was very sensitive. All these local affections were augmented by pressure upon the vertebral column; and especially the rheumatism of the knee, as the author calls it, by pressure upon the lumbar vertebræ.

These nervous diseases do not always stop with the surcharging of the vessels, and the phenomena of congestion or of erysipelas; but the terminations and events of actual inflammation also develope themselves. In hysteric persons, according to Brodie, the most superficial parts of the body, namely, the tip of the nose and the knuckles, sometimes assume a dark color, a vesicle forms, or results in the formation of a thin scab. We might seek the cause of this in a primary kind of paralytic debility of the vessels. But this explanation is not allowable in the following case, quoted from Earle. M. Williams thrust a fork into her arm, wounding the external cutaneous nerves somewhere in the middle of the forearm. Soon she experienced violent pain in the entire course of the nerve, and the region around the wound became considerably inflamed. She was ordered to keep the arm perfectly quiet, and to apply cooling fomentations. Something like three weeks after the injury she strained the arm, whereupon she was suddenly attacked with pain and a sensation of burning in the wound. Soon a rosy inflammation spread over the whole anterior surface of the forearm, and terminated in the

formation of a blister. The arm apparently healed as in pemphigus. The same event occurred subsequently as often as she used the arm. The inflammation never extended farther than over the place mentioned. During the whole course of the disease, the nerve was exceedingly sensitive to pressure. Therefore, not only among simple cases of erysipelas, but also among other forms of eruptive disease, cases may happen which, according to their nature and essence, are to be enumerated amongst the local nervous diseases. This is tolerably certain of that semi-lateral disease known under the name of zoster, where the exudation is the accompanying symptom of a neuralgia dorso-intercostalis. According to Romberg, prurigo likewise belongs to the neuralgia, because the redness of the skin and the papillary eruption only appear after the commencement of the itching, and again vanish with it. Teale has observed several cases where neuralgia of the mamma led to knotty indurations in the breast; and Balleir derives the painful hypertrophy of the neck of the womb which sometimes exists in neuralgia lumbo-abdominalis, and by Bassereau was considered as the cause of this neuralgia, with greater probability from the continued congestions which accompany the neuralgia.

The relations here discussed manifest themselves most frequently and most clearly through the nerves of feeling or touch (in a limited sense so called); and on this account I have hitherto referred to these alone. But they probably take place in like manner between other sensitive nerves and their vessels. At least, we do not doubt that a too powerful excitement or concussion of the nerves of sight and hearing might lead to congestive affections of the organs concerned; and we know that a congestion already existing, in whatever way caused, is increased by over-exertions of the sense affected.

b. Diminished Excitement of Sensitive, with Increased Excitement of the Vascular Nerves.

In anæsthesia we find the results sometimes of paralysis, sometimes of spasm of the vessels. But these cases are not sufficiently pure to deduce laws therefrom. The condition of

the nerves of sensation itself, whether the conduction be only interrupted or their energy destroyed, may not readily nor easily be determined; it depends upon the simultaneous action of the motor cerebro-spinal nerves, upon the seat of the organic cause of the disturbance, whether the vascular nerves are directly or indirectly affected by these; finally, in particular with regard to sight and hearing, it depends upon the action of the sensitive apparatus, as this may lose its faculty of conduction by the exudation. The investigation is necessarily limited to the condition of the vessels in the cold.

Grant that the feeling of cold corresponds to a diminished excitement of the nerves of touch, and, accordingly, that the objective cold, or, to speak more correctly, the withdrawal of heat, is to be considered as a potency depressing the nerves of touch; then, in the rule, with the depression of the nerves of touch must coincide the elevation of the tone of the vessels. We find chilliness with paleness amounting to a venous livid color and with collapse, from being chilled by external causes, in the ague, in cyanosis, in affections of the mind, as fear or dread, in most cases of lead-colic, and locally in many contractions. Both phenomena, as, on the other hand, a sensation of heat or pain and turgescence, are so connected to and conditioned by each other, that we may indeed meet with the excitation or depression of the one class of nerves *without the opposite*, but never *with the homonymous* changes in the other class. The connexion is so constant that both phenomena happen together even where, from the nature of the case or from the objective symptoms, we should not expect either. If cold under some circumstances produces pain, so also at the same time it causes redness; if in ague the skin feels cold in spite of the elevated temperature of the internal parts, so are the vessels also contracted. The contradictions which render difficult an investigation concerning the effects of heat and cold are referred to physical and organic events, but do not meddle with the relation of the parts of an organ to each other.

In regard to this, it remains to ascertain why sympathy of the vessels in the conditions of excitement of the nerves of sense is sometimes present, sometimes absent. We consider that, in

influences from the periphery outwardly, if they are only intense enough, the reflex action upon the vessels never fails, and that it can fail only in excitation of the sensitive nerves from within outwardly, for instance, in the neuralgiæ; so we must conjecture that it depends upon the expansion of excitement in the nerves of sense. In objective irritation, the nerve is always affected throughout its entire length, from the peripheric to the central extremity; in subjective irritation, the affection may extend along the nerve as far as to the periphery, but it may also remain centrally limited. In the first case, the vessels are implicated, as in the reaction from external irritants; in the second case, they remain unaffected. To this explanation is opposed the fact that paralysis of the vessels is not, with equal frequency, associated with the neuralgias of different nerves; it almost regularly accompanies the neuralgias of the face and of the mammary glands, whilst it scarcely ever happens in the ischias. From this it is probable that the greater or lesser facility of association depends upon other anatomical peculiarities of the course of the nerves, unless we assume that ischias and prosopalgia are different diseases according to their internal causes.

The sympathy of the animal and vascular nerves, no matter whether exhibited externally, as synergy or as antagonism, seems, as far as concerns the relation of locality, entirely in accordance with the phenomena of reflexion. In the rule, as we conclude from the facts adduced, reaction is limited to the place of irritation, whether this may depend upon internal or external causes. So also reflex motion is particularly limited to the muscles of the irritated members. Farther, as certain portions of membrane are sympathetically connected exclusively with definite muscles, so also with certain vascular nerves; for instance, the mucous membrane of the nose and the conjunctiva with the lachrymal glands, the mucous membrane of the mouth with the salivary glands, of the throat with the tonsils, &c. Straining the eyes, which, although it first affects the retina, and perhaps the muscles of the eyes, also causes injection of the

conjunctiva. After irritation of the nervus supraorbitalis, Romberg observed a profuse discharge of tears; after tying the same in a horse, inflammation of the eyelids. Kremers and Stilling have called attention to an intermittent ophthalmia curable by china, which is connected with violent pain in the region of the upper cervical vertebræ. Reflex motions are farther extended in the muscular system by violent irritation and a peculiar predisposition, and so are the reactions of the vessels. Usually, the congestion which accompanies neuralgia is limited to the affected half of the body. In a case of prosopalgia of the right side, communicated by Stannius, in the height of the paroxysm there appeared a copious secretion of tears from both sides, and discharge from both nostrils.

With the observations thus collected, let us now consider more in detail the construction of the internal connexion between the functions of the cerebro-spinal nerves and the nerves of the viscera, on the one side, and the vascular nerves on the other.

Preliminarily, we assert, that the reactions of the vessels from external irritants, cannot be explained by the direct physical operation of the irritant upon the filaments of the vessel. Although it is coincident with the physical effects of heat and cold, that the vessels are expanded by the former and contracted by the latter, still the degree and manner of this expansion and contraction is very different from the changes of cohesion which matter directly undergoes from changes of temperature. The differences of expansion, as I have already mentioned when speaking of the cellular tissue, stand in no relation at all to the difference of temperature; and the same artery in the same temperature may be at one time expanded, at another contracted, according as a higher or lower temperature precedes it. For the effects of other chemical or mechanical irritants, simulating those of heat, we cannot account except by a purely physical explanation.

So, then, I consider it as established, that the so-called inflammatory irritants, for the present abstracted from the influence of temperature, do not operate directly upon the vessels, but

through the interposition *of the centripetal nerves;* and I maintain this position for the following reasons:—

1. The consequence of mechanical and chemical irritation, when it comes in contact with the sensitive superficial surface, is directly opposite to the consequence of direct irritation of the vessels. Mechanical irritation of a vessel causes spasm; mechanical irritation of the skin over the vessel causes paralysis of the vascular membrane. No spasm precedes this paralysis, as I have repeatedly noticed, and as every one may easily observe by a superficial irritation of the conjunctiva or any other membranous region. If, in the onset of inflammation in diaphanous parts, there appears at the moment of irritation a transient contraction of the vessel, then I should consider it as the direct consequence —the subsequent, or rather succeeding dilatation, as an intermediately introduced, indirect consequence of the attack. It coincides entirely with our physiological views of the muscles of the viscera, if I conclude of the vessels, that they are, under usual relations, influenced indirectly by the sensitive nerves, but may also be accessible to direct influences.

2. The participation which the vessels take in voluntary muscular motions, and in neuralgia, proves that the tone of the capillary vessels may be changed by the central organs, and especially by the sensitive nerves; because generally the pain precedes the congestion, as well in every individual paroxysm as in the entire course of the disease; and it will be noticed that neuralgia has already continued some time, before redness and tumefaction of the affected parts set in. We shall, therefore, be the more inclined to adopt the opinion, that even when external influences occasion increased accumulation of blood and exudation, the cause of the phenomena proceeds from the centripetal nerves. In fact, even in these cases, the pain is the first symptom, and the redness and tumefaction increase with it, where both can be observed, unless external mechanical peculiarities of the tissue limit the exudation.

3. Paralysis of the sensitive nerves destroys the effect of the inflammatory irritant, although the function of the vessel, as is demonstrated by the color and turgescence, continues normal.

Budge was able to make deep incisions in the posterior half of animals whose spinal marrow had been divided, without inflammation and ulceration setting in; only some time must elapse after the division of the spinal marrow, because the tone of the nerves is not immediately lost after the intersection. C. Bogt, in a case of rheumatic paralysis of the trigeminus, came to the conclusion that irritation of the conjunctiva excited no discharge of tears. Dixon has made known two similar observations: the conjunctiva of the eye of one side whose sensation, was lost, did not become red upon irritation; the nasal mucous membrane was dry; ammonia caused no discharge of tears; the iris was contractile. In the second of these patients, an inflammation of the eye appeared with the return of sensibility. That in individual instances the sensationless part remains irritable, and, as in the case of Bell, the vessels of the insensible conjunctiva became injected by mere contact with the eye, is a contradiction no more difficult to solve than the fact, that in many cases of paralysed sensation, reflex motions are possible. If the centripetal nerve be still in connexion with the cerebrum, or even with the ganglion Gasseri, and only the conduction to the organ of consciousness interrupted, then it still retains its tone, and with that its faculty of operating upon another nerve.

The inefficacy of cutaneous irritants, sinapisms, &c., in asthenic fevers, likewise teaches, that a certain irritability of the nerves is requisite, in order to depress the tone of the vessels.

On this point, in the next place, experience argues, that existing inflammations are obviated by cutting through the sensitive nerves of the diseased part. Inflammation of the hoof-bone,—the so-called founder,—Hausman cured by cutting the nerves of the fetlock.

4. I have adduced several examples, where the exudation and congestion did not appear quite so striking in the place of the peripheric irritation as in other more remote localities. This sympathy is not imaginable without the intervention of the nerves. If we imagine ourselves able to explain, since Bichat, many such like remote effects, by a propagation of the irritation along the tract of the mucous membrane, then let us reflect with what lightning speed this propagation must ensue, in order to

pass, for instance, from the nasal mucous membrane through the lachrymal duct, lachrymal sac, conjunctiva, and excretories of the lachrymal gland to this latter organ! And really, is the propagation of excitement in a membrane so entirely a matter of course, so thoroughly understood, as never to need an explanation? It is comprehensible, how a chemical agent in solution operates upon all parts in its immediate vicinity; how the effect of an impetus is continued onwards; how congestion of blood may gradually be extended by continual replenishment of new stagnating particles in the circumference; but how a slight titillation, or the vascular dilatation depending thereon, is communicated to remote and exactly determined localities, this appears to me not at all explained by the continuity of the membranes! But it was so natural to suppose that disease, in whatever place it settled down with a somewhat broad basis, overshadowed its environs, that in general the idea of sympathy has been scarcely thought of, if in all cases only the parts in the immediate vicinity partook of the suffering; if, for example, in all cases only the muscles immediately under an irritated portion of the skin, and not those remote from it, were contracted. The same kind of facts which has led to the adoption of a nervous sympathy between sensitive and motor organs, must determine us also to the recognition of an indirect interposition between the irritation of the membranes and the reaction of the vessels.

For these reasons I call the vascular dilatation in the congestion of irritation *secondary*, and consider it as the effect of excitement of the sensitive nerves. But if, in the special signification which we give to the word, we call it *sympathetic*, or to speak stronger, *antagonistic*, then the change of the sensitive nerves must be referred to a central organ, and in this be transferred to the vascular nerves. In the same manner, if the relation of the vascular to the muscular nerves shall be antagonistic, it must be considered that both are brought into connexion through the gray substance. In accordance with this view, we should then consider that the contracting power of cold, by the depression of the cerebro-spinal nerves, elevates antagonistically the tone of the vessels.

But this application of my hypothesis leads directly to a contradiction. In the first place there is no indubitable analogy for this kind of antagonism. In the great majority of cases, antagonism is so manifested, that the excitement of one part depresses that of another. But for the inverse process, viz., that primary depression of one part produces excitation in another, I know only the example of the retina, which by steady gazing at a dark spot, becomes incited to a more acute perception of the light halo around it, and the irritability of the nerves of the body in paralytic conditions of the brain, of which we shall speak hereafter; both facts which will admit of different explanations. Perhaps local paralysis of individual nerves is quite as little apt to produce the opposite, as the like condition in others. Cold, therefore, in its direct influence upon the vessels and cellular tissue, is an irritant, that is, it promotes or increases contraction, and accordingly is subjected to a kind of proof, similar to that which I have used above, for the indirect *modus operandi* of inflammatory irritants.

With regard to the exceptional position of cold as antagonistic to the vessels, and upon this basis, another hypothesis may be constructed concerning the internal relation between the cerebro-spinal and vascular nerves, which hypothesis has the advantage of not presupposing so many unproved anatomical facts, and which will, in some measure at least, contribute to the advancement of the subject (which is at present too immature to be conclusively decided) by inciting new corroborating or contradictory experiments, and giving rise to a more rigid criticism of the facts observed. What I shall here say of the vessels, at the same time obtains, *mutatis mutandis*, of the contractile cellular tissue.

The calibre of the vessels is contracted by cold, expanded by heat, or as with Pfeufer we may express it, the vital contractility of the vessels is overcome by heat, and is restored by the withdrawal of heat. Whether in these changes of tone we must recognise a direct reaction of the muscular fibres, or a reaction interposed by the motor nerves of the same, will only be decided with the controversy concerning Haller's doctrine of irritability,

and in the mean time must remain doubtful. So also I must leave undecided the relation of the effects of temperature to our ideas of exciting and depressing irritants, and refer all relating to this question to a chapter of special ætiology.

If the abstraction of caloric directly elevates the tone of vessels, then secondarily it limits the exudation, causes paleness and collapse, and finally, on account of impoverished nutrition, the sensation of numbness and cold in the cutaneous nerves, and the difficult motion of the muscles; phenomena, such as must also follow each vascular spasm primarily excited from within.

If heat directly relaxes the contraction of the vessels, then it favors exudation with its consequences, promotes the alternate or reciprocal action of the nerves with the blood-plasma, and is, therefore, in a certain degree indispensable to health.

But now upon the activity of the nerves depends, not merely the subjective sensation of heat, but also the objective production of caloric, to such an extent even, that heat may increase several degrees in excited parts, sensitive or motor, and to the same extent may decrease in paralysed parts. But as far as the vessels are concerned, the source of heat must be a matter of indifference, whether it is supplied from without, or is generated in their immediate vicinity. In fact, even in the external application of heat, it is the caloric generated within the body, obstructed in its radiation, which has an influence upon the vessels. Accordingly, the heat, generated by the action of the nerves, might be the means of locally relaxing the vessels. Deficient production of caloric, like the withdrawal of it by cooling, might promote the contraction of the vessels.

We may not here object, that the matter through whose decomposition by the nervous action heat is set free, is first conducted to the nerves by the blood, and that accordingly augmented exudation already presupposes increased activity. There is always an abundant quantity of plasma in the parenchyma to suffice for the first demands which the excited nerve makes upon the blood, and to introduce further events. It is more doubtful, and future investigations must decide, whether the vacillations

of temperature which the changing energy of the nervous function causes, is sufficient to change the tone of the vessels. I have made some other objections to these views, which I will state, although I do not consider them by any means unanswerable. In the ague of intermittents, during the elevated temperature of the body, there happens not merely the subjective sensation of cold, but also the contraction of the vessels and the cellular tissue. This, with other experiences, only proves that the physical temperature is not the only and absolute measure of the tone of the fibres. If this were the case, no inflammation could withstand our cold changes of temperature, and no ague our means of warming. Thus then it would appear as if the increased activity of the vascular walls themselves, in pursuance of the general law, must generate heat, and, as it were, of its own accord, destroy itself. But that this is not the case may be proved from the fact that the cause of the elevation of the temperature more properly lies in the nervous than in muscular activity.

As for the rest, the above proposed hypothesis serves for the explanation of facts quite as well as does the adoption of a true nervous antagonism. In the first place, with regard to reaction from external irritants, we distinguish two separate factors, the one of which proceeds from the vessels, the other from the centripetal nerves. In the effects of heat and cold both combine, mutually increasing each other; in the reaction against other irritants the influence of the centripetal nerves either primarily predominates, or, at least, it soon overcomes the vascular contraction produced by the direct affection of the vessels. Something similar seems to occur, by way of exception, in the more considerable and rapid cooling of the skin; here, as is well known, immediately or very soon a congestive redness accompanies the violent, even burning pain which a true excitement of the sensitive nerves occasions.

Secondly, our hypothesis explains why the symptoms of irritation of the sensitive nerves will appear as well in the excitement from within as from without, and why a shorter or longer time precedes the vascular dilatation. If this does not at all ensue,

as is sometimes the case in the neuralgiæ, we must suppose that the nervous excitement, like the development of heat, is restricted to the central extremity of the filament.

If, thirdly, after paralysis of sensitive nerves, neither a congestion can be produced, nor an existing inflammation be augmented, then here also is wanting the means of the development of heat, without which the local irritant at best can only make conditional the contraction of the vessels.

Fourthly and lastly, in the familiar relations of the conduction of heat, it is well understood how the expansion and contraction of the vessels progresses in the circumference of the irritated part. It is more difficult to demonstrate the way by which the connexion is established between the irritated nerves and neighboring vessels, *e. g.*, between the Schneiderian membrane and the lachrymal gland. For this reason I think we must in fact adopt a nervous sympathy, and certainly between the sensitive nerves of the mucous membrane and of the gland, so that the expansion of the vessels of the gland would be in turn the secondary effect of the excitement of its sensitive nerves. I have therefore only an indirect, but, as I think, convincing, reason. I mentioned above two observations from Dixon, where, in anæsthesia of the face, the ordinary external irritants of the nose and eyes did not produce lachrymation. One of the patients, in a domestic quarrel, noticed that she could weep only on one side; in passion, also, no tears flowed from the eye whose sensation was lost. As the condition of the vessels did not change, and therefore the connexion of their nerves with the central organs seemed uninterrupted, we must argue that the depression of the tone of the vessels proceeded from the brain through the interposition of the sensitive nerves, in this case branches of the fifth pair, and that the irritation of the nerves of sensation of the nose was communicated to the same branches by irradiation.

If the fundamental principle of our theory is correct, those parts in which the sensitive nerves alone, without the vascular nerves, are paralysed,—in which, therefore, no congestion can be produced by the ordinary irritants,—must still react against

heat and cold by the objective signs of vascular dilatation and reaction. This appears actually to be the case. According to Dieffenbach, newly restored parts of the face, before they become completely sensitive, are more readily exposed to inflammation from frost. Yelloly and Earle have related cases of nervous paralysis; among others, a case where, after section of the nerves of the arm, the forearm and the hand were sensationless and cold, and where extensive inflammation and the formation of vesicles arose from dipping the arm into warm water, or from warm fomentations. So, also, from degrees of temperature which the healthy skin would have endured without any inconvenience or detriment the same events were produced, perhaps in consequence of the contrast between the depressed or low degree of heat peculiar to paralysed parts, and the heat of the media applied.

What was the effect of mechanical irritants upon the parts paralysed is not stated in the observations mentioned; but from others,—from Hausmann, Valentin, Stilling, and Romberg,—we know that these parts ulcerate very readily in the spots compressed, and perish by gangrene. This extreme degree of impoverished nutrition may originate from excessive and continued contraction of the capillary vessels, as well as from excessive exudation. The former is the more probable, judging from the symptoms which I remember to have noticed in frogs and rabbits, after the sciatic nerve had been divided. The falling out of the hair and nails, observed by many after the operation mentioned, would argue atrophy. Mechanical irritation, therefore, even after paralysis of the nerves of touch, causes contraction or spasm of the vessels; and excitement of the nerves of touch by the irritant is the favorable contrivance for overcoming the spasm of the vessel, and introducing an increased supply of the nutritious material.

If, according to the above-proposed fundamental principles, we consider the secondary contraction and dilatation of the vessels as the consequence of a local change of temperature proceeding from other nerves, we establish a new kind of nervous sympathy, where the nerves influence each other through their

peripheric extremities instead of through the central organs;—not by the interposition of ganglionic bulbs, but by a product of the function or nutritive process of the nervous substance, conveyed directly to each other, possibly also from nerves to muscles. Cases of synergy, of reflex and sympathetic motion, would only then be left, as examples of genuine central communication between motor and sensitive organs on the one side, and vessels and cellular tissue on the other. With respect to the cellular tissue, the cases where it is contracted by mechanical irritation of the skin, and simultaneously with the motion of the voluntary muscles, will even the less admit of another interpretation, because the contractile cellular tissue does not contract upon direct mechanical irritation, and must be as it were relaxed by the caloric evolved in muscular motions. The synergies of the vessels are more complex and intricate, because they almost entirely regard the conditions which proceed from internal incitation, and therefore give no unequivocal, decided conclusion concerning the causal connexion of individual symptoms among themselves. Our judgment, therefore, must depend upon the idea which we form of the causes and nature of fever and of contractions, and must be suspended until we come to the discussions upon this subject.

At the conclusion of this intricate discussion, the question still arises, whether there are direct sympathies of the vessels among themselves, or not, and whether there is one central organ for the vessels, in which their nerves unite, and by which all, or, at least, their greater divisions are regulated. These questions are to be answered with great caution. The homogeneous affection of the entire vascular system, which without doubt frequently happens, gives evidence of a common source of its strength only when it is certain that neither a substance admixed with the blood, nor an abnormal function of the heart, nor a general alteration of the cerebro-spinal nerves, is the general simultaneous cause of the change of the vascular tone. I doubt if there is a case where all these conjectures can be excluded. In direct local irritation of the larger vessels, contraction extends to the contiguous branches, and, according to

Hastings, advances peristaltically. This may depend, as in the intestine, upon the peripheric arrangement of the muscular or nervous filaments. The general contraction of the vessels with the cellular tissue, in the local, excessive effect of cold, points to one organ, which, by any one nerve of sensation, is determined to reflex action upon all the vascular nerves and the cellular tissue; but here, also, still remains the evasive subterfuge, that the vessels receive and circulate less blood, partly on account of the spasmodic contraction of the heart, partly on account of the pressure which the contracted cellular tissue makes upon them.

V. SYMPATHIES OF THE BRAIN.

The organ of psychical functions is incited by the nerves of sense, according to the form of their affection, to different manifestations of function which are made known to us as representations, thoughts, or ideas, and, in turn, possess the faculty of inciting, according to the nature of the thoughts, certain motor and certain sensitive nerves, and these again others in a specific manner. Thus originate the more or less different voluntary representations and motions.

The condition of this reciprocal action is a contiguity of the nervous filaments. Without understanding the more minute anatomical detail of this mutual contact, we know that every mechanical disturbance of the same, for example, by extravasation of blood or tumor in the brain, destroys the possibility of any influence of the nerves of the body upon the brain, and *vice versa.* The faculty of voluntary motion is lost, whilst the tone and irritability of the muscular nerves, issuing from the spinal marrow, is preserved. The nerves of sense, irritated on the surface of the body, produce no independent, conscious representations, after interruption of their continuity within the central organ, whilst the peripheric part of the sensitive nerves connected with the spinal marrow still interposes reflex motions, and the central part, which remains in connexion with the brain, may by this be incited to visions or phantasies.

Motor nerves, whose connexion with the organ of thought is interrupted within the central organ, which therefore, without

loss of tone, are capable of no essential voluntary motion, may, notwithstanding, be put in activity by representations, but either indirectly, in a roundabout way, or by representations which, by virtue of their energy or force, extend their influence over a large circumference, and affect a majority of the nerves, breaking through, or, as it were, circumventing the obstacle. I have above collected a number of cases, where paralysed muscles contract, when the symmetrical or contiguous groups of muscles are moved by command of the will. Magnus communicates a very instructive observation:—In a patient of his, all the muscles of the face, the tongue, and the larynx, collectively, were paralysed in consequence of an apoplectic shock; they could not be moved voluntarily, but were contracted by reflexion and when in passion. When the patient laughed, the muscles of the face and the muscles of the larynx also took part in the respiratory motions.

A multitude of motor nerves are primarily and normally in the same condition, in which, in the case before us, the otherwise voluntary muscular nerves were misplaced by an accidental separation of their contiguity. They are the nerves of the properly so-called involuntary organs, of most of the viscera, of the vessels, and the cellular tissue. By the bye, let it be said, that upon this point we may argue, *à posteriori*, upon the anatomical relation, and assume that the nerves of these organs actually terminate in the spinal marrow, or at least, if they ascend into the brain, are differently arranged, in reference to the hemispheres, than the other nerves of the body.

The tone of the legitimately involuntary nerves may be modified by the brain in a threefold manner:—

1. By motion of the contiguous voluntary muscles, with which the involuntary are sympathetically associated; the iris with the muscles of the eye; the heart and lungs with the muscles of the trunk; the intestine with those of the lower extremities.

2. By the voluntary production of ideas or representations, and the voluntary acuteness of function in the sensitive nerves; contraction of the corresponding muscles, as a reflex motion, results from this in the same manner as if from external irritation.

It may seem as if we were able, at will, to make the detrusor urinæ, and the circular fibres of the rectum, contract for the evacuation of the urine and fæces. But in fact it is not the motion which is governed by the will, but the sensation, which, for instance, when the bladder is full, arises in the perinæum and at the extremity of the urethra; and this sensation, when it increases in intensity for a long time, is followed by contraction in the same manner as if it were occasioned without our aid, or, in other words, involuntarily, by the filled condition of the bladder. Many individuals have the power voluntarily to cause that state of the skin which we call *cutis anserina.* Surely this is done only by the vivid representation of the shivering and horripilation.

It is well known, that by close attention to the nerves of sensation, their sensibility to external impression is heightened; and even in the absence of any external irritant, a sensation of weight, pressure, yea, of actual pain, may be produced in them. Accordingly, we should regard this attention as a kind of irritation; and the nerve which is thus excited could, equally well as after excitement from without, reflect its condition by communication upon others, namely, nerves of motion. Such a communication actually takes place. Voluntary muscles readily fall into involuntary contractions, if the attention is closely directed to a contiguous sensitive organ, or to the cutaneous region under which they lie. Holland says:—"If immediately after an attack of spasm, the attention is steadily applied to the member so attacked, a strong inclination to a repetition of the spasm is perceived, and sometimes it is actually repeated by the constant direction of the mind to this part of the body." Thus is explained the origin of spasms, particularly in the involuntary muscles, the nausea, flatulence, asthma, irritation of the bladder, &c., by the close observation of their own bodies, which hypochondriacs for the most part have carried to a climax. The direction of the thoughts to the beat of the heart changes it, and constant watching of the same produces palpitations, and even the objective symptoms of hypertrophy of the heart. So also, attacks of hysteric spasm of the heart and of the muscles of respiration, so much the more certainly take place, the more

confidently they are expected, and so they will sometimes be omitted, as also the reflected spasms after irritation of parts neuralgically affected, if we can succeed in turning the attention of the patients to some other subject. It is hardly necessary to mention, that the contagiousness of spasms depends upon the same cause, as, for instance, that of gaping, vomiting, and coughing.

Romberg is inclined to derive even the organic affections of hypochondriacs from their psychical condition, and, in fact, proximately, from changes of the tone of vessels of the organs to which the centrally-excited sensitive nerves are distributed. Hirsch, on the other hand, considers the essential part of material disturbances as primary, and appeals to the numerous and permanently perverse sensations, which are followed by no objective symptoms. The experience of Youatt teaches how the attention itself can operate upon the vessels. This veterinary surgeon had several times been bitten by mad dogs, but had preserved himself from bad consequences by immediately cauterizing the entire wound. He notwithstanding confesses, that sometimes, when he reflected upon the possible consequences of his former bites, single wounds, for a long time cicatrized, began to itch, became red, and tumefied. Dieffenbach observed, at the moment when he denuded the sexual parts of a lady, for the purpose of examining a tumor, that the labia pudendi and vaginæ became intensely red. As counterpart to this, we may mention how sometimes, in the attempt at catheterism or other operations on the sexual parts, the penis becomes pale, small, and hard, and seems, as it were, to wish to hide itself.

3. The mind produces changes of tone in the involuntary muscles by representations of a peculiar kind, which are not representations of the intended motion, and also do not operate always to a great extent, but presuppose a certain corporeal disposition, independent of the mind. Thus, at the first sight of the suckling, the milk begins to flow; by lascivious thoughts, erection of the penis; by the representation of agreeable food, a flow of saliva is excited, but only when the organs concerned are in the proper condition; and this circumstance it is, princi-

pally, which forces upon us the conviction, that the will has no power over the motions here mentioned. Seldom are they, as in the cases adduced, limited to single organs. For the most part, the entire nervous system takes a more or less important share in these motions, whether the representation, like a corporeal instinct, refers to definite organic functions, or, in a purely psychological sense, determines the body to sympathetic affection only in general, and without perceptible reference to one design.

Representations, in connexion with the corporeal changes excited by them, of which in turn we are conscious partly as sensations, partly as dispositions of the muscular system, are called passions. Like conscious sensation and voluntary motion, passion is a phenomenon of the sympathy between the brain and the nerves of the body. The difference lies in the fact that in the one case only single nerves, in the other, large masses of nerves, and among others those also which otherwise only govern the organic functions, are interested in, or partake of, the conditions of the brain. It is, therefore, the extent of sympathy which constitutes the difference, and we shall in future consider the increased inclination to passion exactly as the increased inclination to sympathy. If it is demonstrated that the means which increase the sympathy between the corporeal nerves, also heighten the so-called physical irritability, then we have gained at the same time an authentic proof of our theory of passion, and another means of estimating the degree of the facility or capacity of communication in the nervous system.

With respect to voluntary representation and motion, the nature of the thought determines the communication to this or that sense, to this or that muscular group. So also in passionate thought, according to the nature of the thought which calls forth the passion, are different sensations excited, and different muscles called into play. Whether joy, fear, sorrow, anger, love, or scorn, move the soul, is expressed objectively without a word; but the different objective characters of passion can proceed from nothing else than from the manner in which, and the place where, the contractile fibres are affected. But besides these specific sympathies, there are certain corporeal reac-

tions, common to the passions, and with regard to these I have shown that they begin at the top of the head, and with the mightiness of passion, stride downwards to head and trunk. The skin, whether it answers the irritant by creeping chills or heat, or by formication and horripilation; the muscles, whether they are excited to increased tension or to trembling and paralysis; the vessels, whether they manifest their sympathy in paleness or collapse, or in redness, swelling, and exudations: all serve passion the more readily, and upon the more trifling incentives, the nearer to the brain the nerves enter the central organ.

The reciprocal relation which exists between the nerves of the brain and the corporeal sensations, obtains also in the phenomena of passion. Specific thought produces special conditions of the corporeal nerves; the conditions of the body whence they may be originated, determine the specific direction of the thoughts. Anxiety causes constriction of the bronchia and palpitation of the heart; spasm of the lungs and heart constrains to anxious thoughts. Joy relaxes the constriction of the bronchia; the depression and even the paralysis of these organs, especially after a preceding contraction, disposes to a joyous, hopeful regard of life. Sensible impressions and representations which refer to the sexual functions, excite the sexual organs; local excitement of the sexual organs by eruptions, inflammations, &c., captivates the mind with erotic representations. These corporeal sympathies are the source of the involuntary psychical conditions, especially of the disposition and temper, even within the latitude of health. They may be primarily somatic, or may also be excited by a previous, transient thought, which one finds again, after the lapse of years, if in a striking and momentarily abstracted frame of mind, he retrospectively pursues his train of thoughts; they may even proceed from dreams, which, as Byron says,

> "Would leave a weight upon the waking thoughts."

The connexion between the nerves and body and the brain, I have called in general a sympathetic one. But it follows from what has hitherto been seen, that it is sometimes exhibited as

synergy, sometimes as antagonism. A passionate thought results in consensual motions, and phantoms of the sense; but the functions may be so concentrated in the thought that the motor nerves may fall below the normal tone, even under the medium degree of their excitement. By intensely directed attention upon one object the energy of the muscular nerves is diminished, as is shown in the features by a paralytic kind of expression, namely, by the hanging down of the lower jaw, and in passion the limbs may refuse their service, the sphincters open, &c. But inversely, physical activity also depresses physical emotion; anger and vexation, sorrow and joy also exhaust themselves in the half involuntary muscular activities, in the spasmodic respiratory motions, raving, laughing, weeping, which they at first sympathetically produced; and upon the ground of such experiences we see persons undertaking the most ludicrous tricks, twisting the head and distorting the face, and uttering strange sounds, in order to mitigate the acuteness of a disagreeable remembrance that cannot and will not be removed.

The conditions under which synergy and antagonism appear, are quite as obscure here as among all other nervous sympathies. The nature of the passion is certainly of some influence; fear more frequently causes paralysis, anger more frequently an excess of excitement in the corporeal nerves. But fear may also make one capable of extraordinary manifestations of strength, and anger may manifest itself in quaking and trembling. The heart, as has long been acknowledged, has likewise a great influence upon the character or form of passion, and when this organ is inclined to spasmodic contraction, every emotion assumes the character of paralysis. Indeed, I must confess that I have my doubts whether the muscles of the trunk are ever directly paralysed in the so-called depressing passions, and whether the trembling, the debility and faintness do not primarily originate from spasm of the heart through disturbance of the circulation. A very attentive and careful self-observation only can decide this point, and the opportunity of making such observation is not frequent in the life of an individual, if he is fortunate.

A direct communication between the brain and the vascular

nerves is not demonstrable. If the tone of the vessels changes when in a state of passion, there are always present, at the same time, changed sensations, frequently also unusual muscular actions, and upon these the condition of the vessels might proximately depend. We may infer from the above-mentioned observation of Dixon, that where the energy of the sensitive nerve is destroyed, the sympathy of the vessels concerned, in that case of the lachrymal gland, also ceases. The condition of the vessels accommodates or adjusts itself, as in other cases, to the state of excitement of the cerebro-spinal nerves; so that the expansion of the former coincides with augmented, their contraction with diminished, activity of the latter.

I shall speak again, when opportunity offers under the head of abnormal nervous sympathies, of the form of antagonism between the mind and the body, which, as it is believed, manifests itself in spasms and increased irritability of the corporeal nerves when the consciousness is disturbed.

III. SYMPATHIES WHOSE SOURCE IS UNKNOWN.

I mention here, First, the sympathy between the breasts and the womb and ovaries, by virtue of which the irritation of the one or the other of these organs operates at one time synergetically, at another antagonistically upon the consensually connected organ. The breasts enlarge and become painful after conception (synergetically), also after accouchement, and sometimes after the death of the child (antagonistically), although in the latter case they more frequently become flabby and dried up; lactation, for the most part, prevents the appearance of the menses, and restricts the faculty of conception, and if during lactation, by way of exception, menstruation or impregnation takes place, then again the aroused activity of the uterus annihilates the function of the breasts. Vesicants applied to the breasts produce menstruation synergetically, and stop excessive uterine hemorrhages antagonistically.

Secondly. The sympathy between the parotid gland and the breast and ovaries in women, between the parotid gland and the

testicles in men. Rheumatic swelling of the parotid gland is often transferred by metastasis to the organs mentioned, and may be brought back again to this gland by remedies applied externally to the region of the parotid.

These mysterious forms of connexion are teleologically verified, in the first case at least, between the breasts and the uterus; but, in the other cases, they have actually almost the appearance of contingency. In the first, between the breasts and uterus, we ought perhaps to presuppose a nervous connexion for this reason, viz., because the connexion of both these organs seems to be absolutely necessary to the healthy life of the female. The assumption, that their nerves come from one and the same point of the central organs, is supported by the anatomical fact, that the nerves of the breast run their course with the cerebro-spinal nerves; those of the uterus belong to the sympathetic system. In reference to this point, the observation made by Huguier seems to me important, viz., that a woman with a double uterus, who was impregnated only on one side, had milk only in the breast corresponding to the impregnated uterus. But the consensus between the parotid gland of one side and the testicles, breasts, or ovaries of the other side, is exhibited only in disease; and perhaps the metastasis of inflammation, from one gland to the other, in angina parotidea, is more to be attributed to the peculiarity of the disease than to a pre-existing, anatomically-founded connexion of the parts.

I speak not of the different sympathies between the testicles and the larynx, the cheeks or thorax, &c., to the assertion of which many have been misled by the consequences of castration. Extirpation of the testicles or ovaries evidently changes the entire sexual character of the individual; and the effeminate voice, the absence of the beard, &c., are only symptoms of a general anomaly of development which obtains in the entire osseous and muscular systems, in the formation of the adipose substance, perhaps also in the blood, and even in the mental character.

B. ABNORMAL SYMPATHIES.

I. ABNORMAL SYMPATHIES THROUGH THE BLOOD.

The conditions under which the blood may become the interposer of an abnormal, acquired sympathy, are the following:—

1. When the blood contains a new substance, or even only one of the usual ingredients in abnormal proportion, to which two organs shall bear the same mutual relation, and between themselves therefore shall enter into the same antagonistic relation as that in which two sympathetically-connected organs of secretion stand to a normal element of the blood. If, for instance, the blood contained an abnormal excrementitious matter, to the removal of which the skin were delegated, and, besides the skin, the kidneys or any membranes possessed the faculty to attract and remove the same matter, when it was retained in the blood, then a suppression of the cutaneous secretion would be detrimental in a very different manner than under usual circumstances, and other organs than those usually implicated would have to suffer from this disturbance of the function of the skin. I know not whether the existence of such a matter, and its migration in the blood, is established by observation or not; but it is certain that it was adopted by humoral pathologists to aid in explaining why a stagnation of the excretions in certain dyscrasia is very dangerous and detrimental to determined organs; why, for example, in rheumatism or gout, the secretions of the skin could not be suppressed without special detriment to the fibrous or serous structures.

2. If, in any morbid condition of any one part of the body, a consumption of the fluids (*saften*) has become habitual, whether it be evacuated in the form of a sanguineous or other excretion, or is only used in the process of nutrition, then this part is temporarily included among the necessary secreting organs, and is put in sympathetic connexion with those organs which have a similar relation to the blood. Such a new antagonism is established, in chronic dropsy, between the serous cavities affected

and the kidneys, upon which depends the cure of dropsy by means of diuresis. In arthritis, such an antagonism is established between the parts of the body which are the seat of the lithic acid deposit and the kidneys, so that the formation of the chalky concretions or arthritic nodes alternates with the production of gravel and stones in the kidney. Mamma and uterus seem to have a like affinity for the substance which is deposited in the cancerous tumor. If the carcinomatous dyscrasy be present, then extirpation of the mamma may occasion the development of a similar tumor in the uterus.

As for the rest, these cases of morbid sympathy are unfrequent and undetermined. Those parts most frequently suffer from the suppression of abnormal hemorrhages, or secretions from normal or newly-formed secreting organs, which are themselves already in a condition of irritation, the *partes minoris resistentiæ*, on account of which their affinity to the elements of the suppressed secretion is entirely unessential.

II. ABNORMAL NERVOUS SYMPATHIES.

The sympathies of the nerves may deviate from normality in a twofold manner, either from the fact that communication takes place more readily, or to a greater extent, than in the healthy condition, or from the fact that parts are consensually connected with each other, which regularly do not communicate their excitement directly to each other.

This latter kind of unusual sympathies is also called acquired, or individual. It appears as if the irritation could pass over, as it were by leaps, from this to that point, and exempt others, and as if disease, habit, or idiosyncrasy might open a new way of communication into the central organs. But we shall be so much the less inclined to acknowledge this, the more certainly, from the collection of the usual and constantly repeated sympathies, a general and unchangeable anatomical fact, the structure of the central organs, and the arrangement of the primitive filaments, has been proved as the source of the same. By a closer consideration, in fact, it becomes not difficult to discover

the mistake or error upon which that adoption of anomalous sympathies is founded.

In the first place, many of the unusual sympathies, which are enumerated by medical writers and in the manuals, refer to reactions which appear after peculiar affections of the sense. A sympathy is supposed between the organ of smell and the stomach, because disgusting smells excite vomiting; and between the nose and the sexual parts, because there is a smell which arouses sexual desire, and because most animals are invited to coition by the sense of smell. But in all this, a not entirely unimportant intermediate and connecting link is overlooked, namely, the mind. By the perceptions of the sense we are irritated, not alone in a greater or lesser degree, but also in a definitely qualified manner. The quality of sensible impression produces representations, and these again corresponding sensations or motions. In this way, it is possible for an object of sight or any other sense to occasion vomiting, or erection, or even voluntary motion, according to the representation or the passion which it produces.

In the second place, if one part of the nervous system, from whatever cause, is more irritable than the rest, this part is pre-eminently affected during any general excitement; it seems, as it were, to stand in relation to every part of the organism. He who has a predisposition to toothache, may bring on an attack from overloading the stomach. If, from this circumstance, we derive a sympathy between the teeth and the stomach, we overlook the fact, that on the one hand the nerves of the affected tooth have their sympathies also exalted with all other parts, and that, on the other hand, a gastric affection has a certain reflex action upon other nerves also, but only in lesser degree. I shall hereafter mention several other examples of unusual sympathies, arising from want of equilibrium in the conditions of excitement of the nervous system.

In the third place, it remains to be investigated, whether single individual sympathies coincide with variations in the course of the nerves or not; although no case has yet occurred to me which may not admit of some other explanation.

Before we proceed to the investigation of the *abnormally increased disposition* to sympathies, we must consider the external conditions upon which the accomplishment and the propagation of communication depend. They are the two following:—

1. The strength of the *irritation*. Volkmann says:—If an amphibious animal is irritated by gentle titillation, immediately after decapitation, the motion excited is often restricted to the immediate vicinity of the irritated point. Thus the gentle titillation of one toe exclusively sometimes succeeds in producing motions of the foot; but by a somewhat stronger irritant, the entire limb, of which only one part is touched, is set in motion. By still stronger irritants, finally, the motions are extended over all the muscles; and next to those, of the homonymous limb of the other side, and then also over the other extremities. Grainger also declares, that the extent of motion in all cases depends upon the intensity of the irritant. Thus also, in a perfectly healthy body, a violent sensation, and especially a loud noise, even if we are prepared for it beforehand, may occasion a general startling; and a wound by which one nerve is lacerated or inflamed, may become the cause of tetanic spasms.

Reflex motions are the most proper sphere for the study of the laws of communication in the central organs, because both the exciting cause and the propagation of the effect, are here most readily, and even objectively perceptible. But they are, as is evident from the foregoing, only one of many kinds of communication, and what obtains for reflected motions obtains also for other kinds of communication, for sympathetic sensation and sympathetic motion. Now the great majority of general spasms, as epilepsy, tetanus, &c., are accompanied by pains. In the convulsive starting from fright is usually experienced also horripilation, chill, or increased heat throughout the body, luminous flashes, salt taste in the mouth, &c., &c. And in the same manner, the propagation or spread of pain by communication is regulated according to its intensity.* Even the sympathetic

* In this respect, the theory which ascribes reflected motions to an instinctive kind of soul operating unconsciously but with conformity to design, contradicts itself, because notwithstanding the convulsive twitches from cutaneous

motions which accompany a voluntarily intended motion are so much the more active and extensive, the greater the exertion which the will occasions in the originally excited muscular group.

2. Communication depends upon *the kind of irritation.* A sudden, instantaneous, even though violent agitation of the nerves, a blow, a stab, or a push, does not excite reflex motions as readily as a repeated, though entirely superficial contact, especially a constant rubbing of the skin, or titillation. From the slight titillation of a circumscribed spot of the skin, the sympathetic sensations may become almost insupportable, and may usually be mitigated only by firm pressure of the hand upon the irritated spot, almost exactly as the vibrations of a sonorous body are checked by pressure upon it. A person who can be indifferent to violent pains, may still hardly be able to defend himself from the shivering and nervous twitches which accompany a slight itching of the ear. Instinctively, therefore, by rubbing and scratching, we substitute in the place of the superficially itching sensation one stronger, deeper and more painful, but easier to be borne. The reflex exciting, and thereby vivifying, power of cold is manifested pre-eminently when the effect follows simultaneously with shivering and horripilation, as in sprinkling with cold water.

This difference of reaction is not attributable to the heterogeneousness of the impression upon the sensorium; because even in paraplegic limbs, tickling produces more violent reflex motions than pinching.

Experiments furnish entirely analogous results. Volkmann found (and many have since corroborated his views), that a nerve lying exposed must be irritated tolerably strong in order to produce reflex motions, whereas the slightest irritant upon the cutis

irritation, the cough from irritation of the glottis, &c., have the appearance of complete conformity to the design of avoiding or removing the irritant, still it is in no respect necessary that horripilation or tastes upon the tongue should occur. Here, as everywhere in the organism, is seen wisdom and conformity of means to the end in the first arrangement, whereby it happens remotely, that its reactions which follow of necessity, serve also at the same time for the promotion of its existence.

when covered by the epidermis, does not fail of its effect. Longet remarks, in accordance with Cruveilhier, that, whilst in the living animal a slight irritation of the respiratory mucous membrane is sufficient to excite cough, irritation of the nervus vagus itself never has this effect. The experiments of Romberg, Budge and Valentine, teach that in this assertion Longet goes too far, and that direct irritation of the vagus does in fact produce that reflex motion; still that effect, at all events, is much more uncertain. The cause of this, in my opinion, is not to be sought in a functional or anatomical difference between the peripheric portion of the nervous filaments and that part which runs its course in the trunk, but in the fact that an irritation like that of titillation, slightly touching several filaments successively in one tract of their course is not possible in the trunks of nerves, or at least, would not be attempted. The peripheric extremities of the nerves are differently affected by superficial and violent irritation, as may be inferred partly from the above-mentioned observations, but most decisively from experiments in producing reflected contractions of the intestines, to which I incidentally referred above. From slight contact, scratching or titillation of the internal or external surface of the intestine, a feeble annular contraction ensues, which extends to one or both sides, and often sympathetically excites the longitudinal muscular fibres of the intestine, so that the irritated portion rises up. When all voluntary motion is extinct, we may excite it again locally in this way, and the contents of the bowel are by this means urged forward in a normal manner. If the irritation be stronger, a stricture remains in the affected spot, even when peristaltic motion appears in the surrounding region. But if the intestine be violently pinched, lacerated or pierced, then immediately a violent contraction, either lateral or annular, appears, which may render the bowel entirely impassable, which does not increase in extent, and even remains long after the irritability is otherwise extinct. In this case, the peristaltic contractions of the surrounding region are more inconsiderable than from more gentle irritation, or even do not at all appear, although the intestine still stands in connexion with the spinal marrow.

By such experiences, the first assertion that the extent of sympathy increases with the strength of the irritation, of course becomes essentially limited, and without proper regard to the form of irritation we might rather almost come to the opposite conclusion, that gentle irritants are more powerful means of awakening sympathies than violent ones. But now is explained why superficial inflammations of the membranes are accompanied by more considerable and striking reflex actions than the deep and more complicated inflammations; why, for instance, in the most superficial inflammation of the respiratory mucous membrane, the cough is so violent that the disease has been denominated according to this symptom, why sneezing happens from snuffing, and not in *ozœna;* it is farther explained why worms in the intestine occasion more violent nervous symptoms than enteritis, why many purgatives, in weak doses, increase the peristaltic motion of the bowels, and in larger doses, cause colic and constipation, &c.

If now we return to abnormally heightened sympathy, then first of all are we to base the diagnosis of this condition always upon the fact, that the result proves too great compared with the irritant applied. According to the principles which I have laid down in a former place, it should be deduced from this, that in any given case we do not know the entire amount of irritation; that the last irritant, to which we ascribe the effect, is secretly supported by another irritating cause; or, in a word, that the nerves whose reaction strikes us as astonishing, are themselves already in a certain, unusual condition of excitement. The moderate irritant will affect an excited nerve in the same manner and to the same degree, as the immoderate a nerve in a state of repose. Three cases may here be possible, inasmuch as the internal increase of excitement exists either in the primarily, or in the consensually to be excited nerve, or in both. Sympathetic irritation is only one of the multifarious kinds of external influence to which each organ is accessible; the primarily excited nerve, from which communication proceeds, stands to its neighbors in the relation of an exciting substance external to them, and will produce in them a reaction, so much the more vigorous

the more irritated, therefore the more irritable it is when it comes in contact with them.

1. The commencement and the extension of sympathies are promoted by an already present excitement and augmented irritability of the *nerves from which the sympathy proceeds;* therefore, especially of the nerves of sensation to which the irritation is first applied. On this account, many of the above-mentioned sympathies, propagated pains, and spasms, are produced by inflammation; and the normal sympathies, particularly reflex motions, are excited to an activity which is still more detrimental to the function of the organs. In violent ophthalmia, spasmodic closure of the eyelids arises, and extreme contraction of the pupils and lachrymation from a moderate degree of light, although otherwise these phenomena are normal with great degrees of light. For the inflamed mucous membrane of the bladder, the urine at once assumes the property and character of an intense irritant; and the consequence of the irritation from the inflammation and from the urine is a reflex motion, contraction of the *detrusor urinæ*, such as is occasioned by very great dilatation or by acrid matters, when the membrane is not inflamed. The vomiting and colic in inflammation of the stomach and bowels, is explained in the same manner; the cough, even from inspiring cool air, in inflammation of the glottis and trachea, &c.; so also, finally, the passionate excitement in congestions of the brain, in the first stage of hydrocephalus, in phrenitis, and other affections.

I have already spoken of the reflected convulsions which occur in neuralgias; but, as proof of the increased sympathy between the neuralgically affected membrane and its vessels, I here again mention the fact, that irritants, which otherwise produce only slight inflammation, very readily occasion more violent and permanent inflammation and suppuration in parts whose sensitive nerves are already in a condition of augmented excitement. Ley is confident that he has more than once proved this by his experience. In the case of a woman, who suffered violent neuralgia of the abdomen and the whole lower extremities, after accouchement, and probably from irritation or inflammation of the lumbar plexus, he applied leeches to the abdomen. Ul-

cerations ensued, with erysipelatous inflammation, around the leech-bites, which were remarkably sore and sensitive; and weeks passed away before the least appearance of healing was discovered. The same thing happened with another woman, who, in the sixth month of pregnancy, was troubled with small circumscribed tumors (*neuroma*) under the skin, along the tibia. In one case of *neuralgia intercostalis*, the embrocation of an irritating salve on the skin of the thorax produced a severe eruption.

In a former part of this work, I have mentioned contrast as one of the means of increasing the irritability of sensitive nerves and of the brain, at least for a certain quality of irritation. Whether we agree with the explanation of facts there attempted or not, we are obliged to confess, that the sense and the soul receive a more vivid irritation, when they suddenly and unexpectedly fall into a condition of activity, or of repose, opposite to that they are already in. In this increase of irritability is also included a certain increase or promotion of sympathetic excitements. This appears immediately and strikingly in the effects of a rapid transition from darkness to light, from heat to cold, or from cold to heat; and not less clearly does this appear in the impression which a rapid change of contrasted thoughts produces upon the body. We may, in fact, assert, that the effects upon the body, of wit, of contradiction, of sorrow, joy, fear, &c., in great part depend upon the rapidity with which the contradicting representations follow each other, and that these may be avoided in many cases by a preparation for the transition. Upon the same ground is explained the fact, that when the mind is engrossed with a more absorbing subject, the body has so strong an inclination to shrink or be startled by an insignificant irritant; because, in this condition of the mind, all that claims attention from without is unprepared for and in contrast with it. This point only can remain undecided, whether the irritant operates directly from the surprised senses upon the muscles, or whether it operates through the interposition of the mind, and through an emotion of the mind (terror).

2. The commencement and the extension of sympathies is

promoted by increased excitement and excitability of the nerves, which secondarily participate in the excitement of those primarily irritated. Thus, a paroxysm of neuralgia may be excited by motion of neighboring, even though healthy muscles. In a soldier, after an otherwise kindly-healed shot-wound of the face, there remained an excitability of the muscles of the cheek, so that always in speaking, chewing, laughing,—in short, by every motion of any part of the mouth, the under-lip was drawn into a frightful grimace. The impotence from heightened irritability of the vesiculæ seminales, furnishes another example of this kind of morbid sympathy. The muscles of these parts, most generally by excessive use, become so irritable that emission of semen follows a very trifling excitement of the corresponding nerves of sensation. But it is easy to demonstrate, that in this case, the increased excitability of the nerves of sensation is not the cause of the rapid contraction; because, in higher degrees of this affection, the semen is evacuated even without friction, by mere representation, and in fact by other motor nerves, through sympathetic motion; as, for instance, by general exertion, defecation, &c.

Upon the same principle it follows that, by general irradiation from any one point of the nervous system, the consensual excitement must be particularly intense or active in those muscular or sensitive nerves which are already suffering with increased irritability. Patients afflicted with lung diseases, not only cough more readily from irritants which affect the sensitive nerves of the glottis, but they cough also from irritation of remote parts of the body, from general exertions, from laughing, &c., therefore, through sympathetic motion; and, in this way, the increased irritability of the respiratory muscles is manifested. In this view, the following case of disease is very instructive:—A powerful, and otherwise healthy man, suffered with repeated convulsive attacks of cough, which sometimes even passed into tetanic spasms. The cough appeared spontaneously, but could be excited by direct pressure upon the vertebral column, from the second to the fourth cervical vertebræ, by gentle contact with the region of the left shoulder and the epigastric region (re-

flected), and always by laughing (sympathetic motion). The nerves of the pectoral muscles, therefore, were in this case the irritable part, from which, as it were, communication again took place through the motor cords. In persons affected with disease of the heart, this organ stands in the same relation to the whole system ; and every pain, every loud sound, each bodily exertion, produces palpitation. Among pregnant women, the muscular fibres of the uterus are the irritable part, which may be thrown into spasm from almost every point. The forms of spasm peculiar to hysteric patients, may be excited by the greatest variety of impressions, and from almost every point of the skin. A young man, who was under my observation for a long time, suffered with the affection usually called cardialgia, and which in his case, as in many others, had its seat in the colon transversum. The pressure of his clothes excited pain, particularly after a meal, and probably also a local stricture, because immediately the abdomen became distended, and the attack terminated with rapid emission of flatus. But these pains, with all their consequences, were also produced by mere bodily exertions; and, what is most remarkable, by emotions of the mind, fright, sudden waking from sleep, &c. Comparetti noticed something similar in a lady, who was often tormented with colic pains in the right hypochondrium. In these cases, I have no doubt but that a portion of the large intestines, perhaps first rendered irritable by external influence, has such a prevailing control over the nerves of all the intestines, that in excitement it is always to a certain extent, in advance of the rest, and reacts more than other parts from general influences.

In that part of the nervous system embracing the posterior cords of the spinal marrow, it still more frequently happens, that a more irritable, that is, a more irritated nerve feels the consequences of irradiation before the rest, even when it escapes observation in other parts. Among men it is well known, that feelings of disgust, of terror, yea, even of passion, which stream through the entire body, awaken the most striking sensations in the region of the most sensitive parts, in the perinæum and penis. If a person suffers from a wound, or an ulcer, he feels pain in it during agi-

tating emotions, and also during the reflex motions caused by titillation, &c.

What sympathies may be awakened by excitement, depends not alone upon the character of the emotion, but also upon the relative disposition or tone of the peripheric nerves; and so the same emotion may, according to circumstances, cause palpitation of the heart, asthma, icterus, diarrhœa, pains, or spasms.

I have before shown (page 153) how an irritated part becomes the *locus minoris resistentiæ;* so that physical and psychical influences seem to affect it rather than others, and so that, where they are of the same kind and strength, they differ widely in their effects. What is here communicated now furnishes an explanation of most of those cases.

3. Sympathies are promoted by an elevated tone and increased irritability of the *larger groups of nerves*, or of the *collective nervous system*, which demonstrates that the cause of alteration should be sought in the central organs. A certain excitability of the whole body, and a certain degree of vital energy, are necessary, in order that sympathies may appear. This also is taught by Volkmann's experiments, and may be very easily corroborated, viz.: "That the more inconsiderable is the amount of irritability, so much the more limited are the motions, the intensity of the irritants being equal. Thus, a long time after decapitation, we cannot succeed, by irritation of one member, in producing motion in any other parts than those irritated." The capacity to reflex motions may be exhausted by repeated irritation, as experiments on animals as well as on men paraplegically paralysed teach. Corresponding to the original, individually different tone of the nervous system, as it appears in the different temperaments, we see the nerves of different bodies sometimes more isolated, sometimes standing in closer connexion; so that the irritation of each one, more or less easily, draws the whole organism into sympathetic participation with it. All substances which we know to act as nervous irritants, are also means of promoting sympathies, particularly the narcotica, and, to a certain degree, wine. In the most moderate, gently exciting doses, they heighten the fancy and desires; that is, they promote the reci-

procal action between the soul and the corporeal nerves, so that the picture comes more readily to the recollection, the fact to the conclusion. Stronger applied, they make one act vehemently, and, by tendency to sympathetic motion, awkwardly. In larger doses, the narcotica produce a disposition to spasms, which, in order to be developed, await the consensual excitement by sensitive or motor nerves; in their full, complete action, they produce such spasms of themselves alone, and without any other external inducement or occasion. If by these means, or any other influences, a body is supplied with the tendency to spasms, then, often the most insignificant irritation of any one sensitive nerve, such as the shutting of a door, harsh contact, a strong odor, or even the thought of making any one motion, is sufficient to bring on the attack.

On the contrary, where a condition of augmented irritation evidently lies in the nerves which are its recipients, in those sympathetically affected, or in both, where, accordingly, the increased disposition to sympathetic communication coincides exactly with the increased irritability, others are inferred, in which the cause of anomalous sympathies is not so evident; cases, in which the transition from one filament to another is promoted by interruption of the usual conduction to the brain; even by a species of general relations, to which, on account of their causes and phenomena, we must ascribe the character of debility. Lest I incur the risk of collecting together conditions which are only similar in symptoms, but very different in their nature, I will divide them into the following categories:—

1. Every kind of sympathetic communication is increased in the nerves, which, by a separation of continuity, are deprived of the direct influence of the will, but still are so far in connexion with the spinal marrow that their tone is preserved, therefore, in hemiplegic and paraplegic parts; for the most part, also, in limbs which are paralysed by apoplexy. The disposition of such limbs to reflex motions is well known; they are consensually excited, not merely by titillation of the skin immediately covering them, but also by irritation of places far remote from them, and by irritants which, in the healthy, hardly ever produce re-

action. Holland's hemiplegically paralysed patient, to whom I have alluded above, experienced convulsive twitches in the arm, whenever a seton, inserted near the lumbar vertebræ, was dressed. Kurschner's patient, whom I have also mentioned before, was affected with convulsions in the arm and leg of the paralysed side, after the application of a sinapism; and from an itching of the nose, the paralysed arm was involuntarily drawn towards the irritated part. In a case of hemiplegia, described by Marshall Hall, the arm and leg were spasmodically moved by tickling the sole of the foot; and by sprinkling with cold water the face or the breast, only the paralysed limbs were convulsed. In another case, introduction of the catheter caused erection of the penis and convulsive motions of the legs. I have above communicated a number of examples of the tendency of paralysed limbs to symmetrical and simultaneous sympathetic motion. When in passion, the muscles of the eyes, the arm, and leg, of a hemiplegic patient, were contracted, whilst the muscles of the well side remained unaffected. A boy experienced spasms in the paralysed half of the body, even from threatening to sprinkle him with cold water. I cited a case described by Magnus, where the paralysed facial and laryngeal muscles participated in the motions of laughing. Even after the motions of the diaphragm and the external respiratory muscles, which conducted normally, had ceased, still the tone peculiar to the laugh continued for a long time, much to the annoyance of the patient. The larynx could not be brought into a state of repose again as soon as the voluntary muscles. Finally, as a symptom of sympathetic communication between *sensitive* and *vascular* nerves, *antagonistically* increased, I mention the tendency to inflammations of the epidermis, and particularly of the serous and mucous membranes of parts which are paralysed by injury of the spinal marrow, or of parts which are included within the affected region. In a hemiplegic person, of two equally large cutaneous surfaces denuded by vesicants, that of the paralysed side secretes much more abundantly. Inflammations and ulcerations in the kidneys and mucous membranes of the bladder are very frequent after injuries of the medulla spinalis. The altered

quality of the urine of paraplegic patients has been long known, but was first correctly noticed and examined by Blizard, Curling, Brodie, and Budd; the cause of it is the admixture of pus which is formed in the urinary ducts. As in persons paraplegically paralysed, the usual excitant of the bladder, the urine, has such an irritating effect upon the muscles of the same, that the bladder does not endure the usual degree of dilatation, or is even permanently contracted, so it also becomes a source of violent irritation for the mucous membrane of the same, and gives occasion to inflammation and ulceration.*

But the nerves of paralysed parts are not merely more sensitive or susceptible of sympathetic communication; but they are more sensitive to every kind of irritation. Strychnine operates more powerfully upon the muscles of the paralysed limbs than upon others; in hemiplegics, the muscles of the paralysed side are more strongly affected by galvanism than those of the healthy side. Further, clonic spasms, permanent contractions, continued erections, &c., happen in paralysed parts, and this seems, therefore, a higher grade of disease, because in ordinary cases an external stimulus is necessary to produce spasms, or contractions. Therefore, in paralysed parts the heightened sympathy is only the effluence of a higher excitability, and hence it is not the sympathy which we are called upon to explain, but the heightened, reinvigorated tone of the paralysed nerves.

As a knowledge of the irritability of paralysed parts of the body had primarily to be acquired by means of reflex motions

* In the anatomico-physiological preliminaries of the nervous system, I placed together, without farther discussion, these and similar facts, which prove a connexion between the conduct of the central organs and the vessels, and now it is demonstrated that these facts allow of different explanations. The nerves of the vessels might take root in the central organs, and, by injury of the latter, become paralysed; but, if the paralysis proceeds secondarily and antagonistically from the irritation of the sensitive nerves (and this is possible, as I will demonstrate immediately, as well in apparent paralytic conditions as in irritation of the spinal marrow), then could the communication also take place without the central organs, for instance, in the spinal ganglia; and if we derive the influence of irritation of sensitive nerves upon the calibre of the vessels from a peripheric process, then the former observations allow of no conclusion at all upon the anatomical conduct of the nerves of the vessels.

it was natural to consider an interruption of the sensorial functions as the cause of this fact. To the brain was ascribed a force or power restricting reflex motions, which force, with the moving influence of the brain, was lost upon the muscular nerves, or a metastasis (*ueberspringen*) of the irritant from the sensitive to the motor filaments was adopted, when those were prevented from conveying the impression to the sensorium. All such like theories are easily refuted at the present day. Disturbance of consciousness alone does not increase the disposition to sympathies. We may extirpate the cerebrum, and even the cerebellum of animals; as is well known, they become in the first instance destitute of will, in the second, unable to maintain their equilibrium; but yet reflex motions arise, as I have thoroughly convinced myself by experiments on animals, not only thus mutilated, but also upon those uninjured. Interrupted conduction in the sensitive nerves is not the cause of this, because the muscular nerves react abnormally even when motion alone is destroyed, and the sensation of a paralysed part remains uninjured; the muscular nerves are consensually excited as well by other muscular nerves, and by the nerves of the brain, as by the sensitive nerves.

If we know that the cause of irritability lies in a permanently irritated condition of the nerves which issue from the injured part, then are we justly led to the adoption of a pathological change in the locality concerned, which, like tumefaction, congestion, and inflammation, appears with the symptoms of increased excitement. If, after apoplexy, or after injuries of the spinal marrow from external violence, the exudation is not entirely absorbed, or forms a bad scar, or an ecchymosis, then it may easily be perceived how such could interrupt the connexion between the sensorium and nerves, or spinal marrow, and at the same time become the cause of increased excitement in the nerves, so that spasm, contraction, or, at least, an increase of the consensual phenomena arises. This event is so much the more probable, if days elapse after the injury, before the tendency to sympathetic communication appears, as it must immediately appear if the interruption of the brain's influence has the importance ascribed to it. In two cases reported by Budd,

reflex motions happened for the first time on the second and third day after the injury; in a case mentioned by Marshall Hall, the side paralysed after an attack of apoplexy, at first re-acted weaker than the healthy side, was affected by less violent motions, and only until after some time had elapsed, inverted this relation. The following observation related in detail by Brodie, is particularly instructive: A man, fifty-five years old, fell from a scaffold upon his back. All the parts below the epigastrium were instantly paralysed. After nine days, by pressure upon the thigh, gentle twitches of the muscles were for the first time noticed. Subsequently, violent and painful spasms made their appearance when any part of the body was pressed, even by the weight of the bed-clothes. Finally the spasms became continuous, and disturbed his sleep. After death, which took place nine weeks after the fall, it was ascertained that the fourth dorsal vertebra was broken, and so diverted from its place that it pressed a little upon the spinal marrow. In the posterior mediastinum was an abscess, which contained from four to six ounces of pus, and was in connexion with the fracture. The membranes of the spinal marrow were normal; the spinal marrow itself seemed healthy externally, but by making a longitudinal section in it, the central part was found softened.

Budd likewise appeals to dissections to prove that the place of *solutio continui* in the spinal marrow, could become the central seat of irritation. Brodie says, that pains are very frequently experienced in paralysed and insensible parts, after injuries of the spinal marrow. The patient complains of a sensation of soreness, burning, or constriction. Strychnine causes spasms in paralysed parts, and also pains. This may serve to prove, that the cerebral end of the divided spinal marrow is inflamed, or in a similar condition, and again allows a conclusion concerning the cause of spasms, and of the increased irritability in the lower peripheric extremity of the spinal marrow. It may not be objected, that a condition of irritation could not exist so long a time in like manner, without terminating in ulceration or complete disorganization, because contraction and spasm in paralysed parts often remain permanently unchanged. Numberless observations

teach, that more or less violent shocks, pains and convulsions in the external nerves, from neuroma, compressed cicatrices, &c., continue on for many years, and, what is still more remarkable, can be removed instantly by removing the irritating cause. Jeffreys relates a case where a piece of a porcelain vase stuck in the cheek, caused facial pains and paralysis for fourteen years, which was removed by extracting the same.

2. After decapitation, the trunk, as long as it retains its vitality, has an increased tendency to sympathies. Convulsions immediately follow the operation; when quiet is for once restored, they do not spontaneously appear again, but may be excited readily by the most trifling irritation of the skin. Other sympathies, *e. g.*, reflex motions, may not it is true be discovered in this case. That the tone of the nerves is exalted, is only probable from the nature of the case, and from analogy, but cannot be proved. In searching out the cause of these reflex motions, hitherto only the want of consciousness has hovered before the eyes of physiologists, and certainly the loss of the head is the first consequence of decapitation! But a still nearer result, which particularly belongs to the remaining portion of spinal marrow, is the injury of the same by the operation, and this seems to have been entirely overlooked. I have already mentioned that the loss of that part of the brain, which principally serves the psychical functions, does not incline to reflex motions; only the parts whose sensitive and motor filaments are encountered on the incised surface of the central organ become more irritable. It was found that after division of the spinal marrow, the irritability in the parts which still stand in connexion with the brain was not increased, and this immunity was ascribed to the presence of the brain, instead of simply acknowledging that the nerves issuing beyond the injured spot have not at all suffered, and that at most the sensitive nerves happening in the cut surface can give occasion to pains, and these pains and the loss of blood to spasms, but otherwise no cause at all is present from which an excitement could be expected.

3. Most of the phenomena of the so-called nervous irritability, or irritable debility, which are developed by exhausting influences

in the stage of reconvalescence after severe diseases, after the loss of blood and humors, too long-continued lactation, profuse emission of semen, &c., &c., depend upon heightened sympathy. There are inclination to spasms, to weeping, to laughing, shuddering, to changes of respiration and beat of the heart, &c., from psychical impressions, and from impressions upon the sensitive nerves; furthermore, inclination to sympathetic motions, particularly of the muscles of respiration and of the heart during bodily exertions, and to changes in the tone of the vascular system by every kind of nervous activity. Such individuals rapidly change color, perspire very easily, and have a particular disposition to congestions.

If it is conceded that spontaneous convulsions, phantasies, and delirium, indicate a condition of irritation of the corresponding parts of the nervous system, still in these conditions the tendency to sympathetic communication is only a symptom of increased excitement in each individual part; only that the excitability at the same time partakes of the character of erethism, is easily exhausted and changes readily. Delirium, phantasies, convulsions appear spontaneously in distinctly marked cases of anemia, to which all that class of affections may be referred; in the rapid withdrawal of blood by hemorrhage or venesection, they precede syncope, and in chronic conditions of exhaustion, collapse, connected here at the same time with an increased acuteness of sense, and augmented sensibility to light and sound.

It is more difficult to ascertain the cause of irritation for this third than for both the former classes. We have here to deal with more complicated relations, as a change of the nervous system evidently proceeds from a quantitatively and qualitatively abnormal condition of the blood, which therefore can only be fully ascertained in connexion with the pathology of the blood. With regard to this point I will only state by way of preliminary, that a mechanical as well as a chemical momentum is presented in explanation of these remarkable facts; a mechanical, in that the hermetical confinement of the cavity for the central organ prohibits a disgorging of its blood-vessels, and therefore a diminution of the mass of blood is not possible without disturbance

in the distribution of the same; a chemical, because by the unequal regeneration of the individual ingredients of the blood a change of mixture or composition may be effected, which, indeed, to the total, collective production may be hindering, and yet to the reciprocal change of matter in the one or the other tissue, may be promoting.

4. Sleep, and the different morbid nervous conditions assimilating sleep, syncope, coma, and others, in the deprivation of self-consciousness and the inability of the organ of thought to control the nerves of the body, are distinguished by a more intimate relation of the latter to each other, from which principally the slighter appearance of reflex motions is caused. Of all kinds of unusually augmented consensus, this were the most unintelligible, if it were indubitably established. Of this fact I confess I am not convinced. From the unexpected fact, that in these conditions, motion generally succeeds sensation, have we not allowed ourselves to be hurried on to the conclusion, that the tendency to reflex motions is really increased? Are the convulsions from contact, titillation, sprinkling with cold water, &c., in fact more extensive in such, than in persons who are awake? And do they not differ from the results of similar irritation upon those whose mind is awake and conscious, only and entirely by the security of their invasion, because to those who are asleep no premeditated and hindering exertions of the will can happen? The deeper and more comatose the sleep is, the more powerful are the means of awakening which are necessary in order to re-establish the connexion between the consciousness and the body, the weaker and more limited are the reflex motions. Would it not be exactly the reverse if interruption of the conduction to the brain promoted sympathies?

As opposed to these doubts I know only of one exception, viz., the phantasies and spasms which appear in the transition from wakefulness to sleep, and in the first stages of sleep, gaping, starting, cramps among the healthy, asthma and angina pectoris in those inclined to these nervous attacks. But all these, as well as the more striking and disturbing dream-like visions or somnambulic phantoms, belong not to normal sleep, but partly to an

excessive irritation which precedes sleep, and which also may be maintained in single regions or parts of the nervous system, partly to a change of the circulation which the horizontal posture induces. That normal sleep of itself does not dispose to spasm, is sufficiently demonstrated by the fact, that hysteric and epileptic spasmodic attacks very seldom occur in persons who are sleeping.

From all that has been said I draw this conclusion, that there is no particular organic disposition to sympathies, and that the extension or propagation of consensus depends alone upon the strength and kind of the irritant, and upon the degree of excitability, or what is the same thing, of excitement. If we will rest satisfied with the hitherto customary formula borrowed from the imponderabilia, that the substance of the central organ is a better conductor, that the nerves allow the irritant to jump from one to the other, or communicate crossways rather than in a longitudinal direction, still at least we should not forget that we have found no explanation for such views, but simply an expression repeating and paraphrasing the facts.

I remark, in conclusion, that in conformity with our explanations, the relations here adduced between the organ of consciousness and the nerves of the body contain or include nothing whereby the assertion may be fundamentally sustained, that by the primary depression of the one, the excitement of the other can be increased. The antagonism between soul and body, also, is demonstrable only in the sense, that primary irritation of the one withdraws the irritant from the other.

IV.

THE RELATIONS OF DISEASE IN REGARD TO TIME.

I. OF THE COURSE OF DISEASE.

The mind, which seeks to comprehend disease, is educated by the consideration of organic nature, and transfers to the former the ideas which it has acquired from the latter. Here, we see in an individual, an animal or a vegetable body, during its existence a sum of activities appear; there, we behold a sum of activities, which appear and disappear with each other, and we refer them to a unity, the disease. Disease is the supposed body of a nature or essence whose functions are the symptoms.

In the same manner, the relations of disease which have regard to time are determined. The organic body developes itself from the simple, single germ—grows and dies; its existence is included within certain temporal limits: the symptoms of disease commence imperceptibly, increase and again diminish, and so it is said of disease, as of the unity, that originates, grows, and perishes; a vital duration is thus ascribed to it. Inasmuch as in the organic body individual functions gradually develope, and others cease, its life is divided into epochs, the ages of life; these are periods of time, through which it steadily advances to the completion of its existence. Inasmuch as to the sum of morbid symptoms new ones are added, and individual ones separate from the complex, the existence of disease is divided into epochs, its stages; these are therefore periods of different duration, but successively connected, through which the disease in constant development proceeds to its termination.

But in the progress of development, through these single epochs, vacillations occupying smaller periods may be observed in many of the phenomena of the organic body. They may be compared to a constantly advancing, undulating, wave-like motion, (which simile has often been used to illustrate the mental development of the individual or the genus,) or still better they may be compared with a spiral movement, which after each circular tour returns nearly to the point from which it started. On this account the smaller divisions of time are called periods, revolutions, and a development is called periodic or rhythmical when such revolution is clearly perceived. The growth of the antlers of the stag, for instance, experiences such a vacillation every year; their nutrition becomes exhausted, and they drop off; but others sprouting up in their place attain their full growth in the next summer; so the duration of the development of the horns is like the vital duration of the animal whose periods of development are yearly. The vital duration of the sexual or generative function in females falls between the sixteenth and forty-fifth year; but in this time its rhythm is a monthly one.

Within the vital duration of a disease also, we recognise an alternate rise and fall of the morbid symptoms, and thereby a division into periods, which return with greater or less regularity. We therefore ascribe to the disease a rhythm, and call periodical or rhythmical diseases, those in which the regular return of certain phenomena is striking, whilst at the same time we suppose the one single cause to be permanent. Single functions of the living organism cease for a certain time, it *sleeps;* single morbid symptoms abate, the disease *slumbers.*

But the exact determination of the vital duration of disease, and whether it may be rhythmical or not, is exceedingly difficult. In the organisms of the animal and vegetable world, we see vital phenomena connected to a concrete, sensibly perceptible body, and we cannot err, when we regard this concrete body as the bearer (*Trager**) or source of the functions, which we now and

* This word is hardly translatable: its literal meaning is *a porter, bearer, holder,* one who is employed to carry things; here it almost needs the interpretation of supporter, sustainer.—Trans.

then perceive in it. If to-day we see an animal awakening from a semi-annual winter's sleep, we know that the vital manifestations belong to the same being or nature, which for half a year before was in like manner active, that the sleep was only an interruption of a definite vital activity, not of life, and that the conditions of sleep and wakefulness are rhythmically repeated periods of the same life.

Of the disease, on the contrary, even when it is founded on entirely palpable, but internal changes, and still more when the changes are obscured from our sensible perception and observation, we recognise only the external, often only the sympathetic phenomena, not the organic cause. If, therefore, it be conceded that the disease or the pathological process stands in the same relation to the symptoms, as the healthy organism to the vital indications, still it may always remain doubtful, in how far collective, perceptible, pathological phenomena belong to the development of one and the same pathological process, and accordingly, whether certain more or less regularly repeated phenomena are periods of a disease, or independent diseases. Some have wished to conside even intermittent fever, not as one disease with periodic exacerbations, but as a series of from two to three fevers. With regard to attacks of disease, which are repeated in long pauses, after one, two, or three years, the question is hardly to be solved empirically. Another difficulty still lies in the fact that the same disease may manifest itself by different kinds of symptoms, or in different places, for instance, gout by podagra, phrenitis, hemorrhoids, &c., so that even a comparison of the symptoms is insufficient—the only thing, in other respects, whereby we can form any conclusion as to the fact of their being attributable to the same cause, and therefore as to the continuation of the cause.

By these remarks I think I have sufficiently denoted the degree of certainty which belongs to investigations concerning the vital relations of disease; and now, as I have again made known our weakness in this point also, I pass on to a more detailed discussion of *the relations of disease which have regard to time.*

A. DURATION OF DISEASE—TYPE.

The oldest division of diseases is that which expresses their duration, viz., into acute and chronic. It is with this division as with almost all the divisions of natural history, abstracted from the purely artificial systems; they are primarily and easily formed from the consideration of extremes, but for those who come after, the task becomes more difficult to arrange the augmented and increasing material, and the doubtful intermediate forms according to the given schema. As easy as it is to distinguish a tree from a lion, so difficult is it to define animals and plants in such a manner, that the ambiguous shifting forms of each (*zweideutigen Navicularien*), may find a definite place. It is even so with diseases. What a vast difference is there in the course and character of scarlatina, pneumonia, and phlegmon, in comparison with carcinoma, tubercular phthisis, and cataract! And, on the other hand, if we review the history of our science, how arduous and almost impracticable the task, I will not say of discovering the cause of this difference, but only of establishing the external, essential character of each one of these groups!

Three considerations, which have been gradually acquired, are involved in the ideas *acute* and *chronic*.

In the first place, they refer to the absolute duration of disease; *acute* is equivalent to "rapidly running its course," *chronic* to "slowly running its course." It was deemed necessary to specify a definite limit, or boundary, which should divide acute and chronic diseases (the twenty-first day by the ancient pathologists), but even this is hazardous and uncertain in the vacillations which are occasioned in the same morbid process by the magnitude of the noxious influence, by the vivacity of individual reaction, and by the nature of the tissue affected. According to this, for instance, a wound of the skin would belong to the *acute*, a wound of the bones to the *chronic* diseases. A strict regard to the duration of diseases, therefore, as it must separate affinities, would have only the value of an artificial principle of division, and in this sense the *morbi acutissimi*, *peracuti*, *subacuti*, have originated. But that criterion is also obsolete and of little

use, on account of the difficulty of determining the beginning and the end of diseases, particularly with those long predisposed, and at last often momentarily fatal hemorrhages, apoplexies, &c.

As far as regards the result, acute and chronic might therefore be interpreted *feverish* and devoid of fever (Reil, Wilmans, Hufeland), and with Reil, fever is synonymous with acute disease. But although the essentially acute diseases are for the most part febrile, and most of the chronic diseases run through their course, as it is said, without participation of the collective organism; still, even in chronic diseases, fever is often an accompaniment of the later stages, and according to the disposition of the constitution, the same acute disease, for instance, catarrh, influenza, cutaneous eruptions, may appear with or without fever.

In the third place, acute diseases are defined as affections with a *regular course*, and a more distinct succession of the stages; chronic diseases, on the contrary, as irregular, vacillating, without determined progression to recovery, or to death. According to this interpretation, acute is synonymous with *typical*, chronic with *atypical*. But in order correctly to understand this discrimination, and to judge of its worth, it is necessary to examine the foundation of *type*, and the proper meaning of the word.

We obtain the type of a species, genus or family, by separating the accidental and special from the general and permanent, in a comparison of a series of individuals, species, or genera. The type of a species is therefore the law for the formation of the individual, and the form of the individual is typical, legitimate; and not merely the form, but the development also, the reactions against external irritants, &c. What degree of mechanical or chemical irritation a being can safely endure, how it may be changed by the same, *in what time* the normal form and composition, as far as is generally possible, will be re-established, depends upon the original organization of that being, and therefore upon the type, abstracted from the extent of individual vacillation. But if the reactions are typical, so are also the diseases, because disease is, according to our definition, nothing else than reaction against unusual irritants. Poison, excessive heat or cold, deprivation of nourishment, mechanical injury,

&c., operate upon all individuals of the same *genus* alike, *and when it appears* otherwise, it is because previous influences have already affected those individuals, and changed their modes of reaction according to determinate laws. The same injury which produces suppuration in man, in birds results in the formation of a hard crust or scab under which the wound heals; in the Salamander the whole injured limb sloughs off, and a new one is formed; in the Polyps, two individuals are formed out of one, inasmuch as each separated part becomes a whole. All this is typically determined by the law of the genus, and they are therefore *typical diseases.*

But in general we hear diseases divided into typical and atypical, into diseases with regular and irregular course. What is the foundation of this distinction?

I have already shown, in a former part of this work, how by a comparison of single cases of disease, as individuals, and by the association of such as resemble each other into higher and higher groups, we arrive at the type of the species, genus, &c. With particular regard to the development in point of time, we call those diseases *typical* which generally resemble each other in their course and duration, besides the other specific characters whereby we recognise several cases of disease as belonging to the same species—*atypical* when their course lies between important deviations, without our being justified in adopting on that account a specific difference.

In the latter respect, it is true, we may again err, and the question is, whether the difference in the course of a disease may not sometimes be a more important generic character, than the more visible symptoms according to which our genera are formed, and whether, for example, a pure inflammation and a scrofulous one do not exhibit their essential nature by more important differences than a scrofulous inflammation and scrofulous phthisis of the lungs.

But the word *atypic* has a double sense: it is, namely, deviating from the type of a genus, and also generally deprived or destitute of the type. An inflammation may be typical or

not; but there is no type for a dyscrasy, at least no typical course.

These differences must also be referred to the ætiological relations of disease, and among these have already been discussed.

Disease is, as we are accustomed to say, the product of two factors, the predisposition and the external noxious influence. The predisposition of the healthy body is the result of its original organization, and therefore legitimate and constant for all individuals of the same species; that product is therefore always adjusted according to the other, the external factor, and varies with it. If the opportunity is sufficiently often presented of observing the effects of one and the same noxious influence, then we can construe a type of the disease which corresponds to this noxious influence. If the same noxious potency is connected with others, it will produce diseases which remind us of that type without exactly following it. If the noxious potencies, upon which a pathological change depends, are seldom or never repeated in the same manner, then the morbid phenomena will indeed resemble each other, at least, in the principal features; but they are never repeated in so corresponding a manner, that one rule of their course could be derived therefrom.

Traumatic influences, under similar circumstances, so frequently affect otherwise normally constituted individuals, that their consequence, inflammation, is apparent in a sufficient number of examples to establish a typical form for the same. If the wounding instrument is poisoned, rough, &c., or if it injure an organ which occasions peculiar reactions, for instance, a vessel or a nerve, the consequent inflammation deviates in reference to symptoms and course from the simplest form of inflammation, according to which the generic characters are formed. The same thing happens if the structure and composition of the wounded body is already changed by previous influences. The disease which now appears has much in common with the typical inflammation, but is distinguished from it by a disproportion in the intensity of single symptoms, and in its course tends not to recovery, or restores itself without external aid, &c. But if a continued injudicious mode of life finally causes an outbreak of

the disease (of which, perhaps, the parents had already laid the germ by similar faults in their mode of life), it must happen miraculously, if, in the two individuals, the whole chain of noxious influences should be repeated in the same order, with like effect and intensity, and without admixture of any kind. The similarity of the cases of disease, even then, would be as incomplete as that of the causes.

It follows that, in general, *typical* diseases are those which originate from a single, sudden, and speedily operating cause; that, on the other hand, *atypical* diseases proceed from gradually or continuously operating causes. Further, that the typical are at the same time the *pure* diseases; on the contrary, *non-typical* is in the rule identical with *specific*, *complicated*, *constitutional*, modified by the influence of predisposing causes. It follows, finally, that typical diseases are those to which belongs no other than the most general predisposition to disease; on the other hand, that most of the non-typical diseases presuppose a particular inclination or predisposition, even hereditary transmission. One exception, to which I shall immediately refer, is made by the cases where the equal and unlimited continuance of a single external morbific influence keeps up the symptoms; and the process, therefore, can be arrested at any time, *ad libitum*, by removing that cause, as is the case, for instance, with the itch.

By classifying diseases according to their course, we have thus far maintained two divisions: in the first, stand diseases with a course vacillating throughout, the *essentially atypic;* in the second, stand diseases which have a typical course, but may also appear atypically. According to logical principles, still a third class is possible; and experience furnishes it, the *essentially typical* diseases, where the complex of the same symptoms seems always to be restricted to the same temporal limits, and the development of the disease may be perhaps abridged, but never protracted in length. I mention, by way of example, the miasmatically contagious exanthems, scarlatina, variola, rubeola, typhus, and others. In these diseases all is legitimate—the interval between the reception of the noxious influence and the

irruption of the first symptoms, the duration of single symptoms, the formation of contagium, the commencement of convalescence, and, if we have in vain expected these at the proper time, we feel convinced that they are hindered or prevented by some new accidental circumstance, which has no necessary connexion with the cause of the disease.

In reference to the cause of the essentially typical diseases, these facts teach, in the next place, that it must be of a specific nature, which does not admit of a connexion with another kind of chemico-physical influence, and accordingly of a change of the product. Therefore, the cause itself, after its reception into the body, must either have its uninterrupted phases of development, of which the individual stages of the disease are only as it were an impression, or it must develope its effects in a corporeal function, or metamorphosis of matter, which cannot be completed except within a certain interval. This last opinion is not supported by a more minute observation of the miasmatically contagious diseases. Their symptoms are composed of cutaneous inflammation and fever. Neither of these complexes of symptoms is in and of itself typical; the course of both is regulated and directed according to the cause which produces it. A comparison of the different feverish, miasmatically-contagious diseases with one another, sufficiently shows this. Acute inflammation, proceeding from one single morbific potency, certainly goes through its course typically, and, in so far, the regular course of the miasmatic contagious disease might be sought in the participation of the cutaneous inflammation. But the disease does not always consist of a simple inflammation. Several eruptions are often developed in the given time; and, besides, the course of inflammation seems to vary more according to its violence and the individual predisposition, than miasmatic diseases do. Finally, there is never such an interval between an injury or chemical irritation and the consequent inflammation, as there is between inoculation and the irruption of the exanthem. It has been asserted, and with some appearance of truth, that the duration of the miasmatically-contagious exanthem, as of the symptoms generally, depends upon the metamorphosis of one of the materials of the blood, with the exhaustion of which the dis-

ease terminates. The well-known experienee, that eontagion does not, or not so soon, again affeet the body whieh has onee endured the disease, is addueed in support of this opinion. I do not deny that this peeuliar phenomenon is eonveniently explained by that hypothesis; not so the legitimate duration of the diseases mentioned. Beeause either the quantity of matter to be metamorphosed in eaeh body is the same; and then the duration of the disease must be in inverse proportion to its violence; or, the quantity of that matter is ehangeable; then must the disease eontinue so mueh the shorter time, the less it is changed, and the duration must therefore be in direet proportion to the violenee of the disease. But neither is the ease. If we exeept the early fatal cases, the duration stands in no determined relation or proportion to the violenee of the disease.

It is, therefore, more probable, that in the legitimate course of the essentially typieal diseases, the morbifie cause itself has the most important influenee, and that the miasm or eontagium also, according to the species of organic being which it affeets, has a legitimate, temporal development.

I now return to answer the question, in how far the ideas *typical* and *atypical* correspond to the ideas *acute* and *chronic*. It has been shown, that neither the absolute duration, nor the aeeompanying fever, are eharaeters, according to which diseases eould be divided into groups naturally and without separating affinities. It is otherwise with the type. Whether the ease is legitimate or not, depends, as was above demonstrated, upon the most essential differenee, namely, upon the ætiological foree. It is of direct influenee upon our judgment of the entire morbid process; yea, even upon the treatment, because it immediately follows, that in non-typieal diseases, this must be direeted towards the removing of the predisposed disease, or of the eontinually operating eause. If, therefore, we will use the words *acute* and *chronic*, as has hitherto been done, in order to designate the two prineipal elasses of diseases, which have been established from a mere superfieial eonsideration, and without refleetion, then it seems proper that we should substitute for these words the ideas *typic* and *atypic*.

It so happens, that most of the pure typical diseases are at the same time rapid in their course and accompanied with fever, and most of the complicated or *atypic* diseases are at the same time destitute of fever, and lingering. The first are accompanied with fever, the second destitute of it, because the fever symptoms, like so many other reactions which proceed from the nervous system, only originate from suddenly and rapidly-working influences. Most of the typical diseases are rapid in their course, from causes which cannot be represented in general terms, but can only be derived from the nature of the individual process. The essentially typical diseases are so from causes which may be as little divined as the cause of the longer or shorter vital duration of a species of plants. The rest are so, because most of the morbific causes excite congestions, and because congestion cannot long exist in the healthy body, without terminating in exudation and inflammation; and again, inflammation cannot long exist without passing to one of its terminations.

But there are diseases, as I have already cursorily remarked, which, according to their ætiological relations, are ranked among the typical, and yet slowly run their course. The itch presupposes no disposition, originates from a simple, certainly a continuous cause (the *acarus scabiei*), and has a duration entirely unlimited. Intermittent fever, neuralgias, and rheumatisms likewise appear, without predisposing causes, often from a morbific potency immediately operating, from simply taking cold, of which it is not at all probable that it could continually keep up this affection.

For this reason typical and acute cannot be considered entirely identical; because, although the idea acute must comprehend more than the specification of the duration, it nevertheless must exclude those diseases which run their course slowly. In this case, therefore, acute diseases would embrace only a part of the typical, and in fact only the miasmatically contagious, together with the congestions and inflammations, whose course is always rapid and advancing, and which also in case of any violent cause are always connected with fever. Thus acute is almost identical

with inflammatory, and the custom of language has already so far recognised this identity, that even atypical inflammations appearing as intercurrent in the course of constitutional diseases, are considered as acute forms of disease. Of these it is said, that they may become chronic, if in the more extended or prolonged course of the disease the inflammatory symptoms again subside, and the atypic character becomes again more distinct.

At all events, every pure and typical disease may also pass into a chronic form under the following circumstances:

Complete recovery takes place, if the changes which external potencies have effected in the animal tissues, are completely compensated by the process of nutrition. If the physical or chemical influence has a certain degree of violence, the inorganic vital force of matter is destroyed, and local or general death ensues. But there may be also a middle point between these two extremes; the restoration may not be perfectly accomplished, and the change may be the cause of permanent disturbances of function. It depends upon the strength of the noxious potency, upon the vital power of the body, and upon the peculiarities of the tissue attacked, which of these terminations shall take place. Acute diseases, therefore, are changed into chronic. 1st. When they affect tissues which are not capable of complete regeneration. Notice the inflammations of the epidermis: erysipelas vanishes without leaving a trace of it; varicella and varioloid leave behind superficial scars, which subsequently become indistinguishable; permanent scars arise from inflammations of the cutis, which are deeper, because nature is able to reproduce only simple cellular tissue, and not all the peculiar tissues of the skin, the hair follicles, perspiratory glands, pigment, &c. Such scars upon the skin, unless they are very extensive, produce no further disturbance; we do not call them disease, but only defects, *vitia*, and consider the disease terminated as soon as the scar appears. If the same thing happens in the nervous tissue, which likewise can be reproduced only to a limited extent, a chronic disease ensues, spasm, paralysis, either permanent, or gradually and slowly disappearing, according as the process of

regeneration gradually advances. In these and similar cases, therefore, the disease leaves behind in the body a morbific cause, which is permanent, and consequently produces atypic disease.

2d. Acute diseases become chronic, inasmuch as the vital force of the body in general becomes exhausted by disease, and, therefore, the processes of assimilation, of nutrition, and with these also that of regeneration are depressed. Thus, from acute diseases, even from the miasmatic contagious fevers, arises the *febris nervosa lenta*, a condition of general debility, in which the organs of reproduction participate, and which is thereby augmented and aggravated to that extent, that the external supplies of nourishment cannot be conveyed to the body.

Acute diseases, for the most part, by their energetic progress towards death or recovery, permit us to recognise a succession of definite stages, of which there are generally five.

1st. The stage of incipiency, of premonition (*stadium opportunitatis*, *st. prodromorum*, in contagious diseases *st. latentis contagii*); it sometimes commences suddenly, with a perceptible chill, sometimes gradually, with paleness, ague and shuddering, wandering pains, nausea, and loss of appetite, also with slight fever; symptoms which are common to many diseases, and yet do not indicate the specific form of the affection.

2d. The stage of increment (*st. incrementi*), from the first appearance of the essential morbid symptoms to their complete development.

3d. The height of the disease (*st. acmes*, *staseos*), also the stage called the crisis.

4th. The stage of decrease (*st. decrementi*).

5th. The stage of convalescence (*st. reconvalescentiæ*).

The last stage does not properly belong to the disease; it is the consequence partly of the loss of fluids, partly of the restriction which the compensating power has received through the disease, and is characterized by those recuperative efforts to restore again the mass and the forces of the body by an increase of appetite, additional want of sleep, &c. Sometimes, however, the disease leaves behind a certain predisposition in the organ which was principally attacked, as is the case in inflammations,

and many nervous diseases. The convalescent organ is the *pars minoris resistentiæ*, and may become diseased again from various causes. The new disease, when it is a repetition of the first, is called a relapse, a recidivation (*morbus recidivus*). If new diseases of another kind appear during reconvalescence, and in consequence of the predisposition or proclivity left behind by the first disease, they are called secondary diseases (*morbi secundarii*). Dropsy after scarlatina is an example of such diseases.

The duration of the individual stages for the most part is in proportion to the duration of the entire disease, although there are exceptions. In hydrophobia the *stadium latentis contagii* occupies from four to six weeks, while the disease fully developed terminates in death in less than eight days.

Medical men have always greatly troubled themselves to find out a simple law of calculation, which might determine the absolute duration of acute diseases and their stages. The Hippocratic doctrine prevailed undisputed for a long time, that the fourth, or the seventh day, or the sum of both, or the multiple of the seventh day, the fourteenth, twenty-first, &c., terminate diseases, or denote important turns of the same. Among modern physicians, many deny that there is any proof of these critical days, and pay no attention to them, and explain the declarations of the ancients either directly as an error originating from preconceived opinion, or they vindicate them by supposing that in those times the living might have been more simple, and the progress of disease subjected to fewer disturbances. Notwithstanding the critical days of Hippocrates still have their adherents. Zimmermann found them of influence, even if not upon the so-called crisis, and the termination of disease, still upon the condition of the urine during the same. In most cases the pathological changes of the urine, especially the formation of the brickdust sediment, when it was present during the disease, ceased on determinate days. The time during which the urine appeared abnormal, included a three and a half day period, so that, for instance, in slight cases of angina the normal quality of the urine returned on the fourth day, in other cases and in a pneumonia on the seventh, in a case of facial erysipelas on the eleventh, in

some cases of pneumonia and pleuritis on the fifteenth day, &c. The crisis of local diseases for the most part lay midway between these days.

If acute diseases are at the same time periodic, and the periods embrace more than twenty-four hours, then it is conceivable that the favorable, as well as the particularly unfavorable changes, must coincide with determinate days.

B. PERIODICITY—RHYTHM.

A disease is rhythmical or periodic, if some or all of its symptoms, in certain more or less regular periods, alternately increase and diminish, or disappear, without any external cause to occasion the increase. Those diseases in which no rhythmical exacerbation or remission can be perceived, are called continued diseases.

The usage of language frequently alternates rhythm and type. That a regular periodical process should be called typical, is not in itself to be censured, because, according to the original sense of the word *typical*, nothing but what is regular can be so called; but as the word *type* has received another signification in pathology, it cannot at the same time be used for denoting periodicity, and the less so because there are even *atypic* periods, and a *typus irregularis* is peculiarly a *contradictio in adjecto.* We prefer, therefore, instead of *typus remittens*, *intermittens*, *tertianus*, &c., to say, *rhythmus remittens*, &c. But the *typus continens* is neither type nor rhythm, because if the symptoms of a disease were always continued with equal violence, from that very fact, it would not be rhythmical.

A rhythmical disease may be at the same time typical or atypical, acute or chronic.

In rhythmical disease, the disease, that is, the organic cause of the symptoms, continues on, even during the remission of the symptoms, and thereby a periodical disease is distinguished from the *morbus recurrens*, where an external noxious influence is necessary in order to produce the disease, to which there is a continual predisposition. It is the more important to make this distinction, as even in the *morbus recurrens* the attacks often

appear regularly at certain periods of the year or day, where the external morbific potencies directly influence them. In the same manner, also, periodically repeated diseases may arise from relatively external noxious influences, that is, from those formed within the body: for instance, periodical colic, periodical irritation of the urinary organs, may be caused by small gall or kidney stones, which are constantly produced *de novo*, and always affect the cavities in which they are contained only when they have reached a certain part of them. I have above stated the reason why it is difficult in practice to distinguish the periodical from the recurrent disease. Unfortunately, also, it often depends upon the point of view from which we observe the connexion of the phenomena, whether we regard it as one disease, with rhythmical exacerbations, or as a series of isolated diseases. There are individuals who, at yearly, or still longer intervals, are attacked with gastric, particularly with gastro-bilious fever. Now, if we consider the constitution which predisposes to such diseases, as already the disease itself, then the attacks of fever are single paroxysms of a periodical disease. The transitions from the condition of health to that of disease are so imperceptible, that the explanation of this process will always be subjected to a certain kind of arbitrariness.

All pathological symptoms are only the phenomena of the physiological vital process under changed conditions. So also rhythm in disease is nothing else than the rhythm of the normal vital process itself. This in diseases may become more distinct; it may become changed, obliterated, and even disappear entirely, as, for instance, in mania, and other nervous diseases, every trace of the periodic exacerbation and remission of the nervous activity is often lost between the time of sleep and waking. But in every case, there are only two causes to which the periodicity of disease is to be referred: either the noxious potency operates rhythmically (of which we have spoken), or the morbid symptom depends upon the changed function of an organ, whose healthy life is periodical.

We have then first to ascertain the cause of periodicity in the normal vital processes. Then, in order to ascertain the cause of

periodicity in special diseases, it is necessary to find out those which are rhythmical among the physiological processes. Because all vital processes are not rhythmical, although all are typical. Moreover, it will be seen, that the kind of rhythm, that is, the duration of single periods, for different physiological systems, is different, and as the rhythm of healthy life is apparent in diseases, so from the kind of pathological rhythm we may conclude to what system the rhythmical diseases belong.

PERIODICITY OF HEALTHY LIFE.

Periodicity cannot be explained from the laws of excitement alone. Exhaustion results from irritation, because by external irritants the vital forces are consumed more rapidly than they are reproduced. The excitement is artificial, the depression abnormal. Not so in the relations of which we here speak. Exacerbation and remission are here dependent upon external irritants, abstracted from those which are necessary to the support of the body; because exacerbation ensues also without irritation, and remission without the irritation being necessarily exhausted. The same thing also happens in the vital phenomena of plants, which are not irritable, and cannot be irritated. The same periodical activity is also connected with the peculiar temporal relations determined by the type of an animal, and as the being lives and grows a long time, and then ceases, without our being able to say why it goes no further; so, there are also within this life, certain vacillations of forces, the cause of which cannot be further ascertained. As far as the vegetative processes are concerned, this is undoubted; if it were not so, how could it be conceived that, in creatures nearly allied, and organized essentially alike, the same function is here rhythmical, there, continuous? Thus the reception of food takes place with many animals continually, with others rhythmically, and in longer or shorter intervals. Regeneration of the epidermis, the hair, the feathers, &c., happens periodically in most animals, but in man continually, so that desquamation and falling out of the hair takes place, in some slight degree, continually. Heat, formation of semen, and the processes of vegetation therewith connected, in most animals

appear in periods, the duration of which is very different in different genera; in man, the sexual function is rhythmical only in so far as a longer or shorter time is necessary for the formation of the semen.

But in the functions of the nervous system, the phenomena of the natural rhythm are so obscured by those of the artificial, that it is perhaps impossible to separate them.

For as each function originally typic, altered by external influence, can be modified so that the form of the animal, and even the vital duration and succession of epochs (precocity) becomes entirely different, so also the duration and succession of arsis and thesis in the vital phenomena may be changed. The yearly rhythm of plants, under certain circumstances, may be altered into a semi-annual one, and the rutting season of animals, under some circumstances, may be called forth at an unusual time, or oftener than is normal, or may be suppressed, &c. So also with sleep and waking, with the reception of nourishment, excretion, &c. The succession may be changed, inverted, or arbitrarily confined to definite periods. Hence, it is remarkable that hunger, sleep, in short, all true rhythmical phenomena, when they have once passed over their time, do not often appear again before the regular time of the following period, and this is the surest proof, that periodicity has still another, deeper cause, than that of exhaustion consequent upon excitement.

The *accidental rhythm*, as I must call this latter, appears particularly in the functions of the nervous system. A moderate activity is endured for a long time; one abnormally increased, is followed by an exhaustion, whose depth and duration is proportional to the excitement. This exhaustion is not perceptible from slight exertion; but it is very distinct in the dazzling spectra that occur in the eye, in the fatigue after muscular motion, &c. The rhythm becomes also more perceptible where the vital power is already exhausted. A continued tone or sound is heard continuously at first, but after awhile in pauses. An object of sight that is looked at continuously for a long time, appears at last alternately distinct and indistinct. The exertion of a voluntary muscle is in the beginning continuous, then trembling,

finally by jerks. Notwithstanding slight oscillations are perceptible, even in the beginning, only the pauses gradually become greater.

Rhythm, in the organic functions, is also generally independent of external influences, although it may be modified by means of the same. It is, therefore, incorrect to seek the cause of rhythm in diseases, external to the diseased body, in the influence of the moon, the position of the sun, the time of day, &c. The ancient ideas, with regard to the influence of the moon upon menstruation, upon the time of accouchement, &c., have long ago been contradicted as erroneous. Men in the polar regions sleep and wake according to the same rhythm as we; and we are not alone in being able designedly to invert the rhythm of sleeping and waking, and to turn night into day. Even plants show a certain independence in the phenomena of their waking and sleeping, although they are, much more than animals, dependent upon the light. If we put plants into a dark room during the day, and expose them to an artificial light at night, we may invert their periods of sleeping and waking, but only after pursuing such a course for several days. If we keep them continually in the dark, or the light, the leaves will still open and close periodically, but irregularly. But the influence of cosmical relations upon the healthy and the sick generally cannot be denied, because the effect of the altitude of the barometer upon the circulation, and of moonlight upon nervous patients, is sufficiently proved; only we must not imagine that the rhythm in organic functions is conditioned by the rhythm in nature. Thus the catamenia or hemorrhoids do not flow every four weeks because the moon fulls every four weeks, for, with many persons, they happen every three weeks, every thirty days, &c., and their paroxysms do not coincide with determinate days of the month. In the same manner, intermittent fever and neuralgia occur in relation with the daily revolution of the earth. Even if, in a majority of cases, the acme of organic periods coincides with certain positions of the globe, as the investigations of Schweig endeavor to demonstrate, it only proves that one of the organic functions, concurring with the periodical phenome-

non, may be promoted by certain telluric influences, to which I shall refer in treating of Ætiology. Thus, darkness favors sleep; and, on that account, it is certainly conformable to nature to sleep in the night; but the alternation of light and darkness is not the cause of the alternation of sleep and wakefulness.

Notwithstanding this, certain diseases, as will be shown hereafter, do constantly make their attack at certain times of the day, from different, but for the most part unknown causes.

In healthy life, the daily rhythmical oscillation between sleep and waking, is the most striking and most general. What change in the organism produces these different conditions, is a question which belongs to the most difficult problems of physiology, and cannot be investigated in detail in this place. But it may at least be asserted, and it has always been so regarded, that the cause of the alternation of sleep and waking lies in certain conditions of the nervous system, opposed to each other, and alternating with each other; and hence that the periods of nervous life are daily, an arsis and a thesis, in twenty-four hours.

The frequency of the heart's beat, of respiration, and the generation of animal heat, depend directly upon the nervous system, and in these functions also a daily rhythm seems to predominate. Still, the observations upon this point are much more difficult, from the multiplicity of external influences which change the pulse and the degree of heat, particularly the meal-times. At least, they coincide in respect to heat. According to the investigations of Baumgarten-Crusius, C. Reil, Gierse, Hallman, and Bergmann, it increases from morning until noon; soon after noon (after eating), it reaches the highest degree; then, again, gradually decreases until evening, and is at the lowest degree in the night (after midnight). This regular course is interrupted by a slight vacillation after breakfast, inasmuch as after this meal, the heat increases somewhat more rapidly, and then again decreases. The evening meal, and even spirituous drinks, enjoyed in the evening, seem not to disturb the regular sinking of the temperature. Hallman, from the collected obser-

vations of Gierse and from his own, groups the following result:—

The proper heat of the healthy, under the tongue, in the mean, amounts to	37°	centigrade.
In the morning, and late in the evening, it stands, under the mean, at	36 7–36·8	"
Increases before midday to	37·3	"
After noon, to	37·5	"

Chossat found these same regular vacillations of temperature in doves. In the rectum of these animals, with equal external warmth (in the mean of 300 experiments), the thermometer rose at noon to 42·22° centigrade; at midnight it went down to 41·48° c. He adds the remarkable fact, that in famishing animals, the midday temperature is about 0·52°; the nightly temperature, on the contrary, about 3·06° lower than in those well fed. The influence of hunger is therefore six times greater at the time of the remission of temperature than at the time of its exacerbation. The vacillations, which, under favorable circumstances, are only slight, appear much more striking if the conditions of the generation of heat, to which the means of nourishment belong, are limited. The fact that the body, in the evening, is so disproportionately more sensitive to the abstraction of heat, than in the morning, accords well with the above statements.

The skin does not in like measure participate in those periodical changes of temperature which are constant in internal parts, as Bergmann mentions. Among others, he observed frequently a particularly warm skin, at evening, exactly during the sinking of the internal temperature; in the morning, during the increase of it, a cool skin, and from this he concludes that the vacillations may be derived from changes not merely of the internal generation of caloric, but also of the loss of caloric by evaporation.

The pulse is slower during sleep than when awake, and in those animals who remain dormant during the winter (*myoxina*) the difference is very striking. But opinions are divided as to whether the frequency of the pulse increases and decreases once or several times in the course of twenty-four hours, and at what

time of the day the greatest frequency occurs. According to Keill, the pulse is slower on an average about ten beats, in the morning than in the evening. Robinson found the least frequency in the morning about eight o'clock, the greatest in the evening from four to six o'clock ; Pelissier the same. On the contrary, according to Knox, Falconer, Nick, and others, the pulse is most frequent in the morning between the hours of eight and nine, and the slowest in the night about three o'clock. From that time it increases in velocity, whether or not the person sleeps (Knox). With this accords the results which Hohl obtained from an examination of the pulse of pregnant females, and of new-born infants, and by auscultation of the heart's beat in the fœtus. In the great majority of these cases the frequency of the pulse was greater in the morning than in the evening, and in the embryo it became slower in the evening, even when the pulse of the mother was accelerated by way of exception. Vierordt, who confined his investigations to the hours of the day between nine A. M. and seven P. M., observed the greatest frequency at mid-day about two o'clock, the least before the twelve o'clock meal ; and from twelve to two o'clock an increase of about fourteen beats. Baumgarten-Crusius also found the greatest acceleration of the pulse about noon after eating, particularly after the siesta ; the least at night ; and an increase of the frequency also after breakfast, which somewhat decreased again towards noon about eleven o'clock. On the contrary, Cullen and Double state that the pulse is more rapid about noon, then it slackens, and towards evening again exacerbates a second time ; and Budge distinguishes even three exacerbations ; he says, the frequency of the pulse increases about six beats from three to six o'clock in the morning, until ten or twelve o'clock ; then it decreases until after two o'clock, experiences a second increase, even when there is no meal in the interim, from three to six, or eight o'clock ; a second decrease until towards midnight ; after that, finally, a third increase from one to two o'clock, and then again a third decrease. The beat of the heart is also the slowest early in the morning, at which time fatigue most readily ensues. The observations which Guy has made upon himself, are entitled

to the most confidence. They show that the pulse is quickest in the morning, and gradually decreases during the day, and is somewhat more rapid and more regular in the evening than in the forenoon. This progress is disturbed by any exciting causes, particularly by eating, so that soon after a meal the frequency of the pulse is increased from ten to twenty beats. But, the number of beats being equal, the effect of excitement is also greater and longer continued in the forenoon, and often the same quantity of food, which in the forenoon accelerates the pulse for a long time, has no effect upon it in the evening. On an average, a pulse of 62·08 beats would be accelerated in the morning about 12·92 beats, in the evening about 7·07 beats, and it continues in the morning 2·02, in the evening 0·09 hours, until the pulse has again decreased to the number of beats it had before dinner. Guy is of the opinion, that the energy of the heart as well as of all other parts of the body is renewed by sleep, that therefore the pulse should naturally be the quickest after sleep, and that its frequency should decrease with the energy of the heart during the day. But according to the above adduced investigations of Knox, sleep has no influence upon the pulse. It is slowest at night, and becomes accelerated towards morning, with or without sleep. Guy contradicts the general opinion, that the pulse is always excited in the evening: he thinks that an apparent general excitation, for the most part also an increased mental vigor towards evening, has given occasion to this opinion, but that this excitement does not extend to the brain. He assures us he has often experienced such an excitement, with redness of the face, and throbbing of the cerebral vessels, but that the pulse on that account was not more frequent, nor more violent than usual.

Accordingly he establishes it as the rule, although not without individual exceptions, that in the healthy the greater frequency of the pulse happens simultaneously with the increase of the production of caloric, and in the morning hours. But that this proportion in relation may be changed by abnormal conditions, is taught by an experiment which Saunders tried on himself. After he had examined his pulse a long time, and found it about four

beats more frequent in the morning than in the evening (60·56), he took tincture of digitalis twice daily, increasing from fifteen drops. From the effect of the tincture, the pulse was accelerated in the first three days to 70 in the morning, and 66 in the evening; on the two following days to 76 in the morning and 70 in the evening; but on the seventh and eighth days, when the dose had been increased to twenty-five drops, the pulse had eighty beats in the morning and ninety in the evening.

The calculations made by Guy, in different patients, furnish a very unexpected result. Fordyce had already maintained, in opposition to the popular opinion, that in rheumatic and other inflammatory fevers the pulse was accelerated in the evening and night scarcely three beats. Guy also in diseases finds the pulse of men usually less frequent in the evening than in the morning; among one hundred and four patients were fifty-nine in whom the pulse was more frequent in the morning, thirty-six in whom it beat more frequently in the evening, and nine in whom there was no difference of pulse. In four cases of phthisis the average pulse was 96 in the morning, 92 in the evening; in three cases of Bright's disease, 78 in the morning, 75 in the evening; in four cases of rheumatism, morning and evening 77; in five cases of nervous affections, 81 in the morning, 75 in the evening. *Vice versa*, among women the evening exacerbation of the pulse was more frequent: it occurred fifty-one times in seventy-six cases, while the pulse decreased in the evening only twenty-five times, and four times remained the same morning and evening.

Thus, the slight comparative middle worth of a small number of heterogeneous observations may be valued, so far at least as it serves to show, that the time has not yet arrived when we are justified, either in applying the oscillations of the normal pulse to the explanation of morbid phenomena, or in concluding from the latter upon the action of the normal circulation.

Respiration is so changed in sleep, that the number of respiratory movements decreases, while on the other hand their depth increases. During the day, according to Vierordt, the number of respirations and the volume of air respired follows the circle

of oscillation described by the same observer for the frequency of the pulse.

In the partaking of food, and in the functions which are connected with the process of digestion, there is manifested in man and the higher animals a certain rhythm, whose periods include not more than twenty-four hours, but in the rule are repeated several times in the twenty-four hours. At present it is not easy to say definitely how far the rhythm of meal-times is conditioned by the organization of the animal, how far by custom and habit. Primarily this depends upon two conditions: upon the impression which the blood, according to its abundance in the means of compensation and renovation, makes upon the nervous system, and upon the condition of the internal membrane of the stomach. The normal condition of the superficies of the stomach is the *conditio sine qua non* whereby hunger is felt; in those congestions of the mucous membrane of the stomach which are entirely superficial, and even destitute of fever, the appetite fails, and every irritated condition of the same may produce the sensation of satiety. For this reason a person may always be able to eat a quarter or a half hour after a meal, but not so easily two or three hours after, and the slightest quantity of food eaten at the usual hour of a meal, awakens the sensation of complete satiety, only that in such a case hunger sometimes reappears somewhat earlier than usual. But that every considerable loss of the fluids of the body and expense of the vital force excites hunger more strongly and at unusual times, is a fact which cannot be attributed to the condition of the stomach, but only to the change of the blood which affects the central organs, and if, after the usual meal-time has expired without partaking of food, the sensation of hunger passes off to make its appearance again only at the next period,—if it is annihilated by mental affections, by narcotics, even without their reception into the stomach, for instance, by chewing tobacco, then the source of the sensation is clearly demonstrated as in the nervous system, even independent of the condition of the blood.

The loss of weight by the urine and transpiration, according to Reil, is less at night than during the day; and exciting

causes, sleep, even spirituous drinks, do not alter this proportion. From his measurements of the secreted quantities of lithic acid, Schweig concludes, in regard to the daily vacillations, that the secretion, generally more abundant in the day than at night, increases from noon until towards four o'clock, decreases from that time until midnight, and exhibits, between midnight and noon, a repeated increase and decrease, which reaches its climax of increase in the morning hours (from seven to eight). About sunrise and sunset, that is, in winter between six and seven in the evening, and the same hours in the morning, a slight diminution of the excretion is perceptible. The number of exceptions to this rule, which expresses the average of all the observations collected, is very considerable. Schweig supports this rule, by demonstrating that the event of death, in diseases and by suicide, is in great measure confined to those times of the day which nearly coincide with the vacillations of the lithic acid excretion. So also has it always been considered a matter of some importance to examine the influence of meal-times upon the density of the urine. Chambert found the urine, which was passed after a meal, pre-eminently abundant in solid ingredients; but, as in France the principal meal takes place in the evening, the secretion must have been most abundant with him in the evening.

Prout, Coathupe, Scharling, and Vierordt have made a calculation of the daily oscillations in the excretion of carbonic acid. According to Prout, the minimum occurs in the night, begins to increase from half past three o'clock in the morning, at first slowly, then more rapidly until noon; from that time the decrease begins, at first rapidly, then slower, until half past eight in the evening. A slight depression sometimes happens between six and eight o'clock in the forenoon. According to Coathupe, the minimum lies between seven and half past eight o'clock in the evening; the maximum, between eight and half past nine o'clock, A. M. Scharling corroborates the opinion, that in general more carbonic acid is furnished during the day than at night, but at the same time he lays great stress upon the disturbing influence of meal-times, so that the maximum, without being re-

stricted to any hour of the day, appears after the principal meal. The minimum is found sometimes in the night, sometimes in the morning, and sometimes in the evening. Vierordt represents the quantity of carbonic acid expired during the day by a curve, which rises from nine to ten, A. M., falls from ten to twelve o'clock, then once more rises until two o'clock, when it reaches the highest point, and again sinks continually until seven o'clock in the evening. With Scharling, he explains the maximum as a decided result of digestion of the midday meal.

Is there a tertian rhythm in the healthy body? Reil and Stark think it probable, and maintain that the changes of temperature of the vital force are greater every third day; but their opinion is evidently based on the fact, that this seems to be the case in diseases. This is about as hypothetical as the opinions of the ancient physicians, that the gall ferments on the third day, that digestion continues for three days; and if this latter supposition were correct, it would only illustrate a tertian type, but not the *rhythmus tertianus*, as the process of digestion is still carried on every day.

I take the liberty of here mentioning some facts of my own observation, which I have often heard corroborated by others: for instance, the muscular pains occasioned by violent strains first make their appearance on the third day after; and that, after a night spent in watching, or one in which the sleep has been very much disturbed, the increased need of sleep is not perceived the next night, but only on the third night succeeding. On the third evening, the disposition to go to sleep commences at an unusually early time, or the sleep is unusually prolonged in the morning. Now, although I do not know how to make use of these facts in explanation of the tertian rhythm, I cannot but think that they are in some way connected with it.

What the ancient authors assert of a *five to seven-day period*, in the increase and decrease of the weight of the body, or of the transpiration, is entirely uncertain; still, it acquires some consequence from the observations of Schweig, concerning a six-day rhythm of the lithic-acid secretion. Within these six-day periods, which may stand in a certain relation to the revolution of

the moon around the earth, the greatest production of lithic acid takes place on the third and fourth days; the second day stands lower, in this respect, than the third and first; the fifth lower than the fourth, and the sixth nearly equal to the second. There are diseases which, *par excellence*, begin or terminate fatally on definite days of these periods.

The monthly rhythm is very distinct in the menstruation of women. With the majority, the catamenia return every twenty-seven or twenty-eight days; and the average of the interval, from a number of deviating cases, will amount to about twenty-seven and a half days. The nutrition of the body also will generally maintain a monthly period. According to Autenrieth and Sommering, the rapidity with which the fœtus grows will decrease in the second month, increase in the third, attain its highest degree in the fourth month, and then again diminish: and the weight of an adult, according to Sanctorius, during every month, increases one or two pounds, and again, towards the end of the month, returns to its former condition by the passage of a copious, turbid, and sedimentous urine. Keill and Reil dispute this: on the contrary, the latter asserts that he has observed an extraordinary thirst and appetite, together with a correspondingly increased digestive power, troubled sleep, and copious, dark urine, seven times within twelve months, and during some days after the full moon. According to Schweig, the quantities of lithic acid which are excreted during the six-day periods, are not equally great: the production of lithic acid is the least after the new moon; it increases before and after the first quarter, decreases again at the time of the full moon, but then again becomes very considerable and remains so, under slight variations, until the time of new moon. Consequently, the intensity of the lithic acid secretion, during one revolution of the moon, may be represented by a double curve, in the same manner as during the daily and six-day period.

From the experiments which Keill, Lining, and Reil have made with great perseverance, and from their investigations concerning the increase in weight of the body, and concerning the quantity of absorbed and secreted matters, there seems also to be

a yearly vacillation in the reproduction of the healthy body. Lining's tables prove that the quantity of urine passed during the day is greater than at night, in the months from November to April, smaller on the contrary from May to October, whilst the quantity of perspiration during the day continually exceeds that of the night. The weight of his body was the greatest in January, the least in October. Sanctorius, also, and Reil find the weight of the body greater in winter than in summer. The quantity of food assimilated, amounted to the most in July; it decreased from that time, in the first quarter until October, increased in the second quarter until January, diminished again till April, and once more increased until July; the quantity of urine and transpiration increased and decreased in inverse proportion. The perspiration was least, the quantity of urine greatest in winter, January and February; the perspiration reached the maximum, the quantity of urine the minimum in July. These proportions are, without doubt, conditioned by the influence of the external temperature; but I adduce them, because they serve to demonstrate an antagonism between the skin and kidneys. According to the statistical tables of Sweden, Paris, Florence, and Wurtemburg, and the modern authenticating statistics of Villermé, Quetelet, Moser, and Meyer, it may be calculated that the maximum of impregnations occurs in spring, the minimum in autumn, which certainly argues an increase of the sexual activity in spring, and, in this respect, coincides exactly with most of the observations of individuals upon themselves. Of the deaths, February numbers the most, July and August the least.

This is all that may be said with any certainty or definiteness concerning the rhythm of healthy functions. From what has been said, it follows that in the life of the nervous system, a daily, in the functions of reproduction and of generation, a monthly, and more obscurely also a yearly periodicity predominates. The daily vacillations in the functions of nutrition seem to be dependent upon the nervous system, and only the six- and seven-day periods, if they are established by further observations,

should be regarded as an independent time of revolution of the reproductive processes.

RHYTHM IN DISEASE.

In disease also, as in health, the accidental rhythm is, first of all, to be distinguished from the natural. Pains and spasms excited by permanent causes, of themselves abate from time to time, because the vital power of the nerves becomes exhausted. Even in pure inflammations, and still more in the complicated, the pains appear in shocks, or increase in violence by paroxysms. Upon the same principal, tetanic and hydrophobic spasms are intermittent. Convulsions, from pathological formations which irritate the brain and spinal marrow, and from inflammation of these organs, cease when, as it is said, the irritability is consumed. The intermittent character of reflected spasms is most striking. In the common catarrh, in croup and hooping-cough, the inflammation is indeed continual, just as when a foreign body is lodged in the air-passages, but the reflex motions, namely, the cough, appear only after longer or shorter pauses, and in paroxysms; so also sneezing from taking snuff, vomiting from irritation of the mucous membrane of the stomach, and colic from inflammation of the bowels. So also, even in the healthy body, labor-pains, and the contractions of the bowel and bladder for the purpose of expelling their contents, appear in paroxysms. But even here it is very difficult exactly to distinguish the accidental from the natural rhythm; because, if we assume that a short intermission of the urgency to stool or urinate is the result of a momentary exhaustion, it will still very often happen, that this unsatisfied necessity is entirely suppressed until the time of the next normal paroxysm.

In general, the accidental periodicity may be recognised from the fact that the intermissions are only short and irregular, and in some measure, correspond to the violence of the paroxysms, that is, they become so much longer, the more the vital force becomes exhausted by the duration or the extent of excitement in the paroxysm. This law also undergoes another modification, from the circumstances that the exciting cause increases in in-

tensity, often to a greater degree than the vital force decreases; on this account, tetanic and hydrophobic spasms follow each other consecutively in always shorter intervals, until the patient dies in the paroxysm, or until all vital force is exhausted, and paralysis appears in the place of excitement. But in other diseases, the aggravations and remissions so exactly coincide with natural periods, that we must consider them as dependent upon these, and here also the duration of the pauses stands less in proportion to the violence of the paroxysm: therefore, the natural rhythm is also usually fixed, *a rhythmus regularis;* the accidental, on the contrary, is erratic, *a rhythmus irregularis,* in the same manner also as the apparent rhythm which originates from the fact, that where there is a continual predisposition to a certain disease, external noxious potencies help to call it forth. This is usually the case with epilepsy, with false croup, (*laryngismus stridulus*) of children, with hysteric spasms, and others.

It has been a question much agitated, whether there are any true continued diseases. This expression is erroneous. Because even the so-called rhythmical diseases are continued, and only the symptoms are rhythmical. The expression should much rather be, are there morbid symptoms with true *typus continens?* They are generally allowed where there are disorganizations. But even with these, it often happens as if the formation of the morbid product (after-product) ensued periodically, more rapid and more slow, or even experienced a cessation of growth, although that which is once formed never disappears again. Only the residua of disease, scars and others, are completely stationary. On the other hand, it is denied that the *typus continens* can be applied to any of the so-called pure functional disturbances; I say so-called, because disturbances of function without changes of matter are not supposable. This also is not entirely correct. It is true that all symptoms dependent upon the nervous system, do not continue uninterruptedly in an equal degree of violence or strength, but this kind of periodicity is accidental, an alternation of excitement and exhaustion: on this account, pains and spasms, and even fever symptoms, always ap-

pear in remissions and exacerbations, although not always with true natural periodicity. There is, on the other hand, scarcely any one symptom that has not sometimes been observed with a regular rhythm, remittent or intermittent: congestions, inflammations, hemorrhages, fluxes and retentions, eruptions, mental diseases and even paralysis, appear at one time more or less continuous, at another in shorter or longer pauses.

The most commom rhythm in diseases is the daily. In the rule, it appears in remitting and typical, but also in intermitting and chronic diseases, namely, in spasms and neuralgiæ. Two exacerbations seldom occur within the space of twenty-four hours, more than two still less frequently. An intermittent fever with two paroxysms in one day, is the *intermittens quotidiana duplex.*

The *rhythmus tertianus* is distinct in intermittent fever, and also in many other diseases with and without fever. It is perceptible in the exacerbations of chronic diseases, and in the quotidian fevers, inasmuch as the paroxysms or exacerbations of unequal days are more violent, as, for instance, in hectic fevers from their beginning, or if the disease is in progress of development, the paroxysms of two successive days resemble each other in violence. Reil has more than once observed the following type in inflammatory diseases: on the first day, commencement of fever, sleeplessness, headache. On the second day in the exacerbation, the same symptoms with the same violence as on the first day. "The paroxysms, which, according to the rule of inflammatory fever, should be aggravated, were not more violent on the second than on the first day, because the irritability was not so much increased on this day." On the third day, exacerbation of the same symptoms, but far more violent. The fourth day like the third. In the fifth exacerbation, violent fever, headache, delirium, convulsions. The sixth day like the fifth. The seventh exacerbation the most violent. On the eighth day, sleep; on the ninth, headache, sleeplessness; on the tenth day, sleep. The eleventh day like the ninth. On the twelfth, return of health.

This appearance of the tertian rhythm throughout quotidian

fever gave the first occasion of the adoption of a compound type, and a compound intermittent fever. The paroxysms which resemble each other in violence are considered as one disease, and so from quotidian fever with a violence of exacerbation alternating every other day, comes the double tertian fever, *febris tertiana duplicata.* From this fever is still distinguished, according to Sauvages, the *febris tertiana duplex*, in which two paroxysms appear in one day, and the following is free from paroxysms. This construction, whereby two similar diseases are affecting the body at the same time, again proceeds from the supposition that the morbid symptoms belong to an independent organism, even if this is originally not decidedly expressed. Only in this way is it possible to see two intermittent fevers in the same body. How singular would it sound, if we should speak of two kinds of headache, or two epilepsies in the same patient, although these diseases do actually appear sometimes with a stronger, sometimes with a weaker paroxysm. In such a case we should rather say, that headache and epilepsy are the expression or manifestation of the same affection, which, according to the violence of the cause, and the amount of irritability of the body, excites at one time stronger, at another weaker sympathies. And even if we should conjecture, that two different causes occasion the paroxysms of pain and of spasm, still this should always be regarded only as a symptom of one and the same organic change, and the second cause only as a reinforcement of the first, not as the cause of a new disease. Now we must argue in this way with regard to intermittent fever, because, as far as we understand it, intermittent fever is nothing more than a symptom, like pains or spasms. But, in the next place, every symptom can always have only one and the same source. Various kinds of changes may be the cause, that a nerve feels pain or interposes spasms, and these changes, on the other hand, may be produced in the most different ways: thus we may say of a headache, that it is primary or sympathetic, proceeding from the stomach or from the eyes, or it may be arthritic or hysteric, &c. But never is headache anything else than the result of an organic change of the nerve, which extends to the affected spot. In the same manner, the

proximate cause of the intermittent fever symptoms, so far as they resemble each other in individual cases, must lie in the affection of the same parts of the organism; each more violent or weaker paroxysm of intermittent fever corresponds to a deeper or more superficial affection of the same, and as in the former case with the pains, so here also, the cause of this alternation lies only in the cause of the disease, or in the irritability, both of which may be periodically aggravated or depressed. The adoption of compound intermittent fevers should only then have any sense, when it is presupposed that the paroxysms of unequal days are sympathetically produced by diseases of different organs, for instance, that affection of the spleen, and liver disease, each occasion an intermittent fever, and in fact each with a tertian type; that somehow the affection proceeding from the disease of the liver should be the stronger, and that accidentally the *arsis* of the one disease should fall in the *thesis* of the other. But this is a point to which no one has alluded, and considering how little is known of intermittent fever, it would be an extremely bold, and at the same time in itself, improbable supposition.

Among the compound fevers also, cases are adduced, where a continued fever is complicated with an intermittent. Such a fever would be more correctly considered as a remittent, as we have no right to separate individual fever symptoms, and to regard them as a special disease in themselves. Therefore, remittent fevers may have a *quotidian*, *tertian*, and *quartan rhythm*, equally as well as intermittents. A remittent fever with tertian exacerbations is the *hemitritaus*, *semitertiana*, *tritaophya*, *amphimerina* of the ancient pathologists, a remittent with quartan exacerbations the *tetartophya*, &c. Lovers of this extreme subtleness may be referred to Burserius, Institutes Med. Prac., vol. i. p. 499.

Intermittent fevers, particularly the autumnal, and many other chronic diseases, frequently exhibit the four-day periods in their course, and this rhythm also may sometimes approximate the daily, inasmuch as on the day after the principal paroxysm a

weaker one succeeds, and only the third, sixth day, &c., are entirely free.

The *rhythmus quintanus* is very doubtful, as its appearance may easily arise from a *tertiana* whose paroxysm is once overlooked or omitted. Fevers are also described whose course occupies from six to ten and fourteen days, and in other diseases, seven and fourteen-day periods have been observed.

The four-weekly rhythm is exhibited with much greater regularity in many diseases which are connected with defects of menstruation, and in hemorrhoids and their so-called metastases, so much so that hemorrhoids, since they have become so general, are considered almost as the substitute for menstruation in men. But they also occur just as regularly in women. One man, aged forty-eight, had suffered in this way every month since his sixteenth year, and his mother was troubled in the same way from her twenty-fifth to her forty-fifth year, notwithstanding she menstruated regularly. Baumgarten-Crusius has collected a great number of cases of pains, spasms and epilepsies, delirium, abscesses, and eruptions, but most of all of hemorrhages, which exacerbated, or were repeated monthly. In the same work of this author, p. 227, we find diseases with quarterly, semi-annual and annual periods. The yearly periodicity is most distinct in podagra, and other arthritic diseases.

Periods longer than a year, are not easy to demonstrate with certainty; still, Testa relates a striking example of a triennial periodicity. Salmasius had a fever, for the first time, in his thirty-eighth year, and then seven times successively every three years after.

Some authors have distinguished a *fixed* and a *movable* type or rhythm. The latter is either anticipating or postponing. But these terms are used in a double sense. A rhythm which, in itself regular, does not exactly coincide with the daily periods, would seem to anticipate or to procrastinate, when the exacerbation happens some hours earlier or later, on every prominent day, that is, the day of the paroxysm, than on the preceding day. Thus it might be said of menstruation, that it anticipates or procrastinates, in case the discharge appears regularly every

three weeks or every thirty days. If an anticipating rhythm of this kind should exist in quotidian fevers, it would then follow that there are still shorter periods than those of four-and-twenty hours. But such a rhythm does not occur; and even in tertian and quartan fevers, it is noticed always only as an exception and temporarily, when the rhythm becomes gradually and not suddenly changed. But the rhythm is anticipated or postponed, when the paroxysms become longer, and the remissions or intermissions shorter. Then the time of revolution remains the same, but the paroxysms usually so much anticipate or postpone as they increase or decrease in duration. In that case, as is natural, the anticipation is a sign of increased, the postponement a sign of diminished violence of the disease.

In the observation of the healthy rhythmical functions, we have found that a daily periodicity predominates in the vitality of the nerves. External irritants of sense, although constantly continued, still lose their efficacy upon the nervous system once in the course of twenty-four hours; and it may be conjectured that the same is the case in the internal abnormal irritation of the nerves. An organic change, continually progressing, must therefore exhibit rhythmical and even daily remissions, because the reaction of the nerves exacerbates, and remits rhythmically and in daily periods. It is probable that the rhythms which are longer than twenty-four hours, at least the three and four-day rhythms, depend upon the same cause, because the quotidian rhythm passes over into the tertian and quartan rhythms, and *vice versa;* and, because it is one of the rules of normal periodicity, that the duration of the periods immediately becomes doubled, if, from any causes whatsoever, an exacerbation or a remission fails. Thus as has been mentioned before, hunger, sleep, an urgent inclination to stool, menstruation, &c., when once suppressed, do not appear again immediately after the suppressing cause has ceased, but only at the time of the next succeeding normal period. Notwithstanding there is, on the other hand, some reason for supposing, that even in the organs of nutrition (*bildenden lebens*), a rhythm takes place which embraces a series of days. For it

is remarkable, that in quartan fevers, the disturbances of nutrition are so much more perceptible, and the affection of the viscera so much more considerable, since, indeed, if we regard the paroxysm as excitement, the longer duration of the intermissions would argue a slighter affection of the nervous system. If we adopt six to seven-day periods, in the process of normal nutrition, the entire duration of many diseases would embrace exactly one or several such periods. The monthly rhythm of diseases is readily explained from the periodicity of the sexual functions in women, and of nutrition in both sexes. The yearly revolution of certain morbid symptoms also may be referred to a yearly rhythm in the growth of the body.

We would therefore, in general terms, refer morbid symptoms with daily rhythm, to the nervous system; with monthly rhythm, to the female sexual organs, or to the organs of reproduction; and symptoms with yearly rhythm, to the latter.

This conclusion, so evident and general as it is, will nevertheless prove somewhat useful, if practically applied. In consequence of the reciprocal action in which the nervous system stands with the organs of nutrition and reproduction, a primary affection of the former may appear in the latter, as inflammation or hemorrhage, dyspepsia and others; and, *vice versa,* defects in sanguification may manifest themselves by nervous symptoms of various kinds. In these cases, as experience has for a long time shown, the rhythm is an important aid in diagnosis.

It is a question very properly suggested in this place, whether the exacerbations and remissions of rhythmical diseases coincide with the natural exacerbations and remissions of healthy life, and are merely the consequences of the latter; or whether the periods of arsis and thesis, in disease, are dependent upon the normal ones, and are perhaps conditioned by the time when the morbific potency first exerted its influence. If the first supposition is correct, the paroxysms of the same disease must appear in all patients at the same hour of the day or night; but, if the first paroxysm is occasioned by the influence of the morbific potency, and the succeeding paroxysms, repeated in definite inter-

vals, are repetitions of the first, then, as the period of the external influence is accidental, the time of exacerbation of the same disease is also different in different patients.

Now, surely it may be asserted of most of the rhythmical diseases, that they make their exacerbation regularly at definite periods of the day. Almost all hysterical affections and neuralgias have this peculiarity, that however torturing they may be during the day, they very seldom disturb the sleep of patients. Many forms of spasm, namely, St. Vitus's Dance, are completely suspended during sleep; and here, therefore, the intermissions of the disease coincide with the natural intermissions. Spasms of the bronchia and of the heart have their paroxysms in the first stage of sleep. The pains of lead colic and arthralgia saturnina are, on the contrary, frequently more violent at night, and intermit during the day. In all the so-called remitting fevers, and in all inflammations, the aggravations appear in the evening. All cutaneous inflammations, as well as scabies, itch most intensely in the evening. The cause of these exacerbations must therefore lie in a condition of the nervous system, which, according to the rule in the healthy body, makes its appearance in the evening. Baumgarten-Crusius, therefore, maintains, that the evening paroxysms are brought on by the preceding meal, and occur simultaneously with the process of digestion; but this cannot be correct, as they occur quite as regularly during complete abstinence from food, and perhaps less violent, from causes which may readily be conceived. Experiences with regard to the normal periodicity of the nervous system, render it improbable that an augmentation of the activity of the heart in the evening should be the cause of these exacerbations. In hectic fever, on the contrary, the influence of meal-time upon the time of the exacerbations cannot be mistaken; and here also, with our mode of life, these do not occur in the evening, but in the afternoon, soon after dinner. The periodical sweats of patients affected with phthisis, seem conditioned by the periods of sleep, as upon every such occasion, and by a high degree of temperature, even with those entirely healthy, the disposition to diaphoresis is increased during the

morning sleep. All osseous pains, not only the syphilitic, but also the arthritic,—the pains in old scars or cicatrices that have grown on to the bones, &c., are accustomed to make their exacerbations after midnight. I have no doubt but that this depends upon the decrease of the development of caloric and of transpiration, as atmospheric influences which abstract caloric and diminish transpiration, such as damp and cold air, always are capable of producing bone-pains.

In other diseases, on the contrary, the periods of exacerbation or of paroxysm, even though they are repeated in each individual case exactly rhythmically, are still less fixed in reference to the times of day. Neuralgias make their exacerbation at every hour, but certainly oftener at night than in the day. It is asserted of intermittent fever, that the quotidian, in the rule, makes its appearance in the morning, the tertian in the afternoon, the quartan in the evening; and yet tertian fevers in the morning, and quotidian in the evening, are not unfrequent,—which certainly cannot be consistently denied, if we explain the evening quotidian fever as a tertiana duplicata. Therefore, either the conditions of the nervous system, which increase its sensibility towards the fever-exciting cause, must appear at different times in different individuals, or the cases which are comprehended under the name of intermittent fever, include several morbid processes different in their nature, or, finally, the time of the paroxysm is simultaneously determined by the beginning of the disease, and therefore by the external morbific potency; and the quotidian is perhaps more frequent in the morning only because the morbific potency which produces it most frequently exercises its influence in the night.

Next to the division of rhythm, according to the duration of the periods, a second division is to be mentioned, according to the completeness of the remission of the symptoms, into rhythmus continens, remittens, and intermittens.

The rhythmus or typus continens, strictly considered, does not exist; and, if a disease should have this type, as has been remarked, it would not be rhythmical. A rhythmus continens is attributed

to those diseases which terminate with one paroxysm (ephemera), and to the remitting diseases generally, when the abatement of the symptoms is very short and irregular, or when exacerbation and remission take place several times in the course of twenty-four hours. Thus considered, the rhythmus continens differs only in degree from the remittent rhythm, and in fact passes over into it when the violence of the disease is abated, just as inversely, where the violence increases, the rhythmus remittens passes into the rhythmus continens.

Rhythmus remittens.—The remission of the morbid symptoms is more striking. Either the whole collective symptoms abate without entirely disappearing, or single symptoms, such as pain and fever, disappear or diminish considerably, while others continue. This type is the usual one in acute diseases of moderate severity, particularly in the miasmatic contagious fevers, and the remissions have especial reference to the fever-symptoms. The paroxysm of remittent diseases is called exacerbation, recrudescence.

Rhythmus intermittens.—Collective morbid symptoms abate in pauses. The disease makes itself manifest in a series of single attacks, and, apart from these, the body does not appear diseased. Here the attack is called a paroxysm; the pauses, intermissions, and, in feverish diseases, apyrexia.

Most of the chronic and atypic diseases exhibit this rhythm, and especially those which are repeated after long pauses, from a month to a year, &c. Among the diseases with shorter periods of revolution, it belongs particularly to those whose symptoms proceed from the nervous system; for example, the neuralgiæ. A disease is remittent, when its phenomena are composed of symptoms which have a continuous course, and which are rhythmical. Thus, an inflammatory fever is remittent, because, although the pain and heat and excitement of the pulse temporarily disappear, still the local inflammatory symptoms, and the immediate consequences of the local affection continue unchanged. But when a disease exhibits no other symptoms than such as depend upon disturbance of nervous function, in the very nature of which it lies that it should from time to time disconti-

nue, then is the disease *intermittent.* This is the case with the neuralgiæ and with intermittent fever. I do not mean to say, that intermittent fever is a primary or pure nervous disease; but the symptoms by which we recognise it, are nervous symptoms. The continued morbid symptoms, if they are present, withdraw themselves from our view, and on this account is the fever intermittent. Sometimes this term *intermittent* is applied to that fever which accompanies other chronic diseases, inasmuch as its symptoms are separated from the rest, as belonging to a particular complex. In this way, we may call hectic fever an intermittent fever.

Moreover, the intermittent type sometimes differs from the remittent only in degree. Inflammations may be so slight, that their remissions are considered as intermissions. Such is sometimes the case with catarrhal inflammations of the eye, which are neither painful during the day nor disturb the sense of sight, and continue entirely unobserved, but make themselves perceptible in the evening by slight itching, and by the influence which the more copiously secreted fluids exercise upon the refraction of the rays of light.

II. OF THE TERMINATIONS OF DISEASE.

Disease terminates either in recovery or in death, or it passes into a new disease.

A. TERMINATION IN RECOVERY.

The termination of disease in recovery ensues with or without artificial assistance: in the latter case it is said, it occurs *of itself, spontaneously, by the help of Nature.*

This discrimination or distinction is not entirely scientific. It dates its origin from a time when physicians, as still now-a-days the people, knew of no other kind of medical influence than that interposed by the apothecary; from the same time in which originated the idea, that the word medicine simultaneously denotes the whole science of the healing art, and the contents of a bottle of physic.

On this point, familiar as it is, it is necessary that we should be reminded in the first place, that not every interference of art, interposed during the course of a disease, has a share in the recovery; in the next place, that strange as it may sound, the physician is a part of nature; and finally, what seems to have been less observed, that nature has at command the same forces, or their similars, of which the physician makes use. It is recommended to the physician to imitate nature; so also does nature, or accident, without recommendation, sometimes imitate the physician; the one as well as the other can excite a bleeding or a secretion, which checks the progress of disease. For the patient whom the physician would send into another climate in order to remove some infirmities, accident provides perhaps a climacteric change in his own native land. And because nature has dominion over many forces, over which the physician has no control, or is considered to have none, such diseases may even recover spontaneously, for the removal of which art could avail nothing. Disease, therefore, may take a favorable termination in accordance with, and in spite of the art of the physician, by virtue of, and in spite of accidental circumstances.

The meaning of that distinction can be no other than that there are morbid processes, to the cure of which no kind of new influences, no matter whether accidentally or designedly introduced, are requisite. Only such recoveries, founded in the terminal development of disease itself, should be called *spontaneous;* the rest are artificial or accidental.

Spontaneous recoveries are accomplished in a twofold way.

1. When morbid vital manifestations (*lebensauszerungen**), are kept up by a continued, active morbific potency, then their duration corresponds to the duration of the cause, and their termination to the discontinuance of the cause. If it is in our power to remove the cause, then we cut short the disease in every period of its existence; then, for instance, we cure the itch by killing the acarus; a neuralgia by extirpation of the neuroma which occasions it. If it be in the nature of a morbific cause, after a given space of time *voluntarily* to abandon the body it has affected,

* Literally, expressions of vitality.

the disease which is produced by it must, after a given space of time *voluntarily* proceed to recovery. If the gad-fly, only in the condition of larva, inhabits human and animal organisms, and if this condition of larva has a typically limited duration, then the symptoms which indicate the presence of the larva also cease without the assistance of art. I have already demonstrated above, that the typical course, and therefore the spontaneous termination also of the miasmatic contagious diseases, must be ascribed to a typical development of their cause.

2. If the morbific cause has in such a manner interfered in a physiological process, that the disturbance excited by it gives occasion to further disturbances; if it is, therefore, no longer the external morbific potency, but the alteration occasioned by it, which maintains the continuance of the abnormal symptoms; then it depends entirely upon the specific nature and direction of the functions set in motion, whether, and how soon they lead to recovery. In the artificial cure of such a disease, as, for instance, a traumatic inflammation, the neutralization of the cause is not to be thought of; the effort of art is immediately directed towards the result, towards the organic change, which forms the point of issue, or at least a necessary link in the chain of pathological functions. The first object, then, will be to make use of remedies whose effect is opposed to the effect of the external cause, depressing remedies if the morbific potency excites, strengthening if it debilitates, &c. Or it will seek to remove, as it were out of the middle, one of the conditions, by virtue of which the pathic process is maintained; it will, for example, oppose local congestion by diminishing the quantity of blood, notwithstanding a wound does not augment the mass of blood.

If an affection is continued beyond the duration of the external cause by the internal conditions of the organism, it can only happen in this manner, viz., that the first, and so on each successive pathological momentum of the lever, becomes a new one; if after a series of such events the normal activity finally returns, this again is not imaginable in any other way than by supposing that the last pathological momentum itself gives the first impetus towards the restoration of the healthy condition. Analogies are

not wanting which in general serve to elucidate this relation; we may perhaps mention the management of steam-boilers, where the ever-increasing expansion of the steam finally lifts the safety-valve, and forces an outlet for itself. But such general reflections are not sufficient for a true understanding of the natural process of cure, and a special demonstration is required of the way in which one stage proceeds from another in the course of specific morbid processes. I will here refer only to one part of this demonstration, namely, how the process, which first gives the impetus towards a favorable termination, stands in connexion, sometimes more, sometimes less direct and necessary, with the series of pathological processes.

The connexion is direct, for instance, when from plethora the vessels of an organ which is congested yield to the pressure of blood, burst, and with the evacuated blood both the cause of congestion and its consequences are removed. The same is the case when an inflammatory exudation, by pressure upon the surrounding parts, excites new inflammation, new exudation, &c., until finally the inflammation and the exudation reach a free surface, break through, and then in the parts relieved of the tension and expansion, the normal sensation and circulation become again possible.

The cure is brought about in an indirect, more accidental way, when the affected organ sympathetically excites another, or transfers its irritation to another, which by virtue of the peculiar nature of its function is capable of removing the causes or the conditions of the disease. To this class of cures belong the very familiar cases, where a membrane, irritated by a noxious potency penetrating from without, or produced in the body, occasions sympathetic muscular contractions, by the assistance of which the noxious potency is removed, or, where by the transfer of irritation upon an organ of secretion, a secretion is formed which acts as a derivative.

In none of these facts shall we find a reason for the adoption of a special curative power of nature antagonistic to the irritant, or even to the disease. And even if in some cases the way which leads from disease to recovery, should be less apparent,

still must we reject an explanation which, in spite of all modern transformations, does not deny its mythical origin, and which, on account of the arbitrariness with which it disposes of facts, may be indeed proper and sufficient for the satisfaction of a popular necessity, but is unworthy of a scientific application.

It is of no avail to assert that this sanative power should be considered as identical with the constant, and, in health, active formative power of the body, so long as we represent it to ourselves as a genius presiding over matter, prepared to oppose every attack with the voluntarily-summoned forces of the organism, according to its, or much rather according to our own discreet judgment. I repeat, by virtue of this formative power, there is primarily distributed to each part, a limited faculty of attracting the general vital irritants, of metamorphosing themselves in their own substance, and of developing themselves typically by means of the same. External influences may destroy this faculty, render it temporarily inactive, or give it another direction, inasmuch as they suppose changed conditions, or by change of one elementary part, they alter its relation to the rest; but when the external influences return to their normal condition, the original formative power regains its rights. It is not aroused by the irritant to the protection of the body, but is diverted from its aim to the detriment of the same. After the irritation has ceased, the conditions reappear under which its legitimacy is constituted. Each reaction is a symptom of disease; the repose and *restitution* which succeeds irritation, is possessed of sanative power.

Abstracted from this power, which is efficacious in the preservation of the individual while in a state of disease, because it is generally efficacious in the preservation of life, the conditions of sympathy and antagonism frequently contain the cause that noxious potencies become inactive and diseases are healed. The noxious potency itself often brings about recovery by the accidental occurrences to which it gives rise. It is lucky that irritation of the mucous membrane of the stomach excites vomiting, and irritation of the glottis cough, because, by means of these sympathetic motions, matters are sometimes expelled or thrown

off, whose continued presence would have endangered the body. But that sympathy is ever constant; this utility merely accidental. Not every poison excites vomiting, not every noxious gas excites cough: moreover, cough arises from superficial inflammation of the trachea, before anything is there to be expelled, and vomiting from injection of tartar emetic into the veins, in which case the emesis is entirely useless. Medical science should at least renounce that pernicious practice, which sets up lawless human prudence instead of the only lawful, Divine Wisdom! Let us spurn from us that logic of newspaper-writers, which distinctly recognises the finger of God in those events which it may need, and in every misfortune finds the decree of the Most High inscrutable. Either it is inscrutable in both or in neither. If a power acts *only sometimes* in accordance with the intention which we ascribe to it, even this very fact is a proof that it obeys a deeper law, and that the coincidence with our ideas was only an accidental thing.

LYSIS—CRISIS.

The transition from disease to recovery, in most of the chronic and in many acute diseases, takes place gradually; so that the morbid symptoms decrease by degrees, an expected paroxysm does not appear, and it is impossible to say from what hour the favorable turn commences in the morbid process. In others, namely, in acute cases, the symptoms disappear suddenly; from the time of an evacuation, from the breaking out of an eruption, of a perspiration, at the time of waking from sleep, the patient feels himself immediately relieved. The moment in which this termination shall commence, may sometimes be predetermined. The first, slow kind of termination of disease, is called *lysis;* the second, sudden, decisive termination, is called *crisis.*

The idea of crisis is a relic, and indeed, perhaps, the most tenacious of the mythical beginnings of the science of medicine. I have shown how the *crudum* and *intemperatum* of the oldest humoral pathologists, which it was supposed the organism must concoct and excrete, pervades all humoral-pathological and even

the solid-pathological systems, in the shape of a fever irritant, an inflammatory irritant, a noxiousness, a morbid organism, a parasite, &c. According to the ancient opinion, crisis is the ejection, by the sanative power of nature, of that noxiousness manufactured in the body. Therefore, crisis always happens by means of an evacuation or a discharge, either abnormally by hemorrhage, exanthems, &c., or normally by a discharge of mucus, urine, fæces, perspiration, saliva, &c. Such a discharge is called *critical.* The symptoms of excitement in the pulse, in the temperature, in the nervous system (delirium, spasm, and others), were looked upon as manifestations or expressions of the activity which was about to accomplish the discharge (*molimina critica*, critical exacerbation). There existed an old prejudice against the cure by lysis, because all wished actually to see the *materia peccans* ejected. The object of treatment, therefore, was to support nature in her critical efforts, and to promote the critical discharges. Modern pathologists have moulded these ideas into very many different shapes; they have restricted them on the one side, on the other they have extended them in a most unreasonable manner.

They have limited them, in so far that they will not at least assert, of every matter discharged at the crisis, that during its previous sojourn in the body, it may have been the cause of the morbid symptoms. They deemed it expedient to allow that the ejected matters were formed only by means of the disease, in consequence of the anomalous function of the solid parts, and that the curative power of nature, when it had got the better of the disease, was immediately concerned only in cleansing the blood from these sediments of the food. The ancient opinion in reference to the acute, contagious diseases, is established, because a substance introduced from without seems first to disappear, as it were, in the internal parts of the body, and then, after it has excited a tumult in the internal organs, reappears again on the surface of the body, and with the excretion of this substance, the disease seems to terminate. This doctrine of the critical efforts and eliminations has been extended in the modern crasian schools to such a degree, that now every product, every excres-

cence, every exudation, is considered as a critical discharge, whereby the blood endeavors to reinstate itself in its purity.

I will first communicate the objections which may be made by empiricism and reflection against the validity of these dogmas, and then endeavor to explain the actual signification of the facts upon which they are constructed.

It has already often been mentioned how frequently, copious and apparently critical discharges appear in diseases without any influence upon the progress of the symptoms, and how often, on the other hand, diseases terminate favorably without any excretion which could be considered as critical. But hardly any one has anticipated how few, according to the more thorough statistical observations of the last year, is the number of cases which are favorable to the doctrine of crisis, in proportion to those which are unfavorable. Among one hundred and thirty cases of pneumonia, which terminated in recovery, Grisolle observed only in thirty-four phenomena which obtained as critical. The most constant of these was a sediment of lithic acid salts in the urine; but even this usually appeared only when convalescence was already decided, and during its progress. With regard to the brick-dust sediments of the urine which obtain as crises of the paroxysms of intermittent fever, Becquerel says, that they are most frequent and most distinct in the first two stages, while in the last stage the urine usually becomes again more clear and transparent. At the end of an intermittent fever, although he often examined the urine, he never saw a sediment deposited spontaneously, or by addition of nitric acid. The statistics of the same observer with regard to the urinary sediment in typhus, teach, that it neither happens on definite days, nor stands in any constant connexion with the process of cure. In typhus and other fevers, the sedimentous urine equally as often precedes the termination in death as in recovery, and only because many kinds of fever terminate more frequently in recovery than in death, has it come to pass, that in the sediment of the urine a presage of recovery has been descried. Among twelve cases of *status gastricus*, once, on the morning of the day in which all the morbid symptoms disappeared, the urine yielded a lithic acid

sediment by means of nitric acid; among eighteen cases of of *rheumatismus acutus* was only one, in which the urinary sediment could be considered as critical; because, although it showed itself often after the cessation of the fever, still for the most part it had also been present before, and even during the entire disease. In pneumonia, the sediments were found most abundant during the greatest violence of the disease, and gradually decreased in quantity as the inflammation declined.

If we sum up the collective experiences of Becquerel, it will be found, that the lithic acid sediment is in direct proportion to the fever: in a moderate fever, they only become apparent upon the addition of nitric acid; in the higher grades of fever, they precipitate spontaneously; it is not wonderful, therefore, that the spontaneous precipitation should have been observed often only at the height of the disease. The urine becomes again clear, sometimes before the recovery takes place, sometimes not until a few days after, and sometimes simultaneously with it. The urinary sediments, therefore, belong not to the critical, but to the *symptomatic* phenomena of the fever, and this is in accordance with the above-adduced statements of Zimmermann. In the first place, then, I must, it is true, leave it undecided in what relation to fever the production of lithic acid shall be considered, but I do not think a particular influence upon the course of disease should be attributed to it, as long as the fatal and favorable cases do not differ in this respect.

The cutaneous crises will be found no less inconstant than the urinary crises, if they are for once subjected to a strict and exact examination. I appeal to a statement of Holland's, where it is said: "With the same course of preceding symptoms we have seen a similar alleviation ensue without the appearance of cutaneous transpiration. This is well known to all physicians who are accustomed to observe the phenomena of fever. Here remissions and intermissions appear; always, it is true, and indubitably with a change of the condition of the cutaneous vessels, but often only with very slight, or even no actual cutaneous perspiration following the hot stage. So also in the simple paroxysm of

an intermittent fever we have sometimes observed the total deficiency of a particular sweating stage; far more frequently, however, in other idiopathic or symptomatic forms of fever.

In the miasmatic contagious diseases, the character of a critical excretion is assigned principally to the exanthem, external or internal, and yet the fever does not disappear with the outbreak of the exanthem, but usually continues with a violence proportional to the same. Again the disease is said to form its crisis by the removal and expulsion of contagium, and in fact in many of these diseases, from special causes, the capacity of infecting ceases simultaneously with the recovery; yet this, as is well known, is not the case with all, but only with the least part of them. In addition to these we hear authors speak of crises by sputa, hemorrhage, perspiration, and urine, in these diseases, and yet it is certain, particularly of the urine, that it does not contain the specific *materia peccans* of contagious fever, which is contagium.

Finally, with regard to the product which the doctrine of crases supposes, I see even here an endeavor to demonstrate anomalies of the blood, and of the matters excreted, and further, the connexion of specific peculiarities in the composition of the blood with the specific products of exudation; but I also see not the shadow of a proof for the assertion that the crasis is primary, and the crisis secondary. Without inquiring into causes and means, this doctrine ascribes to the blood, from which water, spermatic fluid, and fibrin are taken, a necessity and a faculty of removing water, sperm, or fibrin, in order that its normal composition may be re-established. It may know of unfortunate cases, where not enough, or not the right kind has been excreted; of the destructive effects of excretions upon the organs, which nature has selected for the accomplishment of the crisis, or in which she has deposited her secret; but it seems to have been forgotten, that the blood in the first instance by the subtraction which it suffers in consequence of this secretion, may be morbidly altered in its composition, and scarcely, and for certain chronic processes only, has it conceived the idea that there can be such a thing as removing too much, and that in conse-

quence of this *too much* a useless blood may be left behind in the vessels. This most recent humoral pathology considers the blood as the only actuality that is conformable to its design: if it is healthy, it has no cause to secrete; if it secretes, it is not healthy; it secretes only so much and so long as is favorable to its becoming healthy again.

I will only cursorily mention, by way of example, what shape the theory of inflammation has assumed under the influence of this school. Because a number of inflammatory exudations are caused by retained fibrin, an excess of fibrin is ascribed to the blood, and an effort to free itself of the same by means of a crisis. When Andral and Gavarret demonstrated that the fibrinous contents of the blood are actually increased in inflammations, and augment with the violence of the local symptoms, this also was acceptable, although if the theory had been correct, the fibrin in the blood should decrease in quantity, as the local symptoms increase. But this investigating school entirely suppressed the supplementary remark, that the change in the composition of the blood only appeared after the exudation had taken place; whether fibrin is actually contained in relatively greater quantity in the fibrinous exudation, than in the blood, has not been investigated. How does it happen, that the fibrin of the blood is augmented in cases where the exudations are not fibrinous, and particularly where they are? How happens the increase of fibrin in consequence of a local irritant, and why is the blood obliged to remove its fibrin directly to the irritated spot? Such questions, this school has not propounded to itself. Nevertheless it is not necessary to investigate so profoundly. Even the thirst following violent sweats, diarrhœas and others, already proves that the blood may be compelled by external causes to yield more of one of its ingredients, than is for its good, and that on this account the so-called *crisis* may be the cause of the so-called *crasis*.

In saying thus we shall not of course dispute, that the blood and the product may stand in the same proportion to each other, which Humoral Pathology has hitherto had exclusively in view. Only a few will doubt that dropsy, cancer, tubercle, and similar

excretions, are the consequences of a peculiar degeneration of the blood. But on the other hand, these exudations are not critical in the sense, that the blood becomes purified by their aid. They are symptoms of a dyscrasy, which does not cease perfecting itself during the formation of the pathological product, and often, as it were by the internal development of the latter, does it first take an unfavorable turn.

So much for critical products. And now with regard to the adoption of critical molimina, I have shown in the introduction, from whence originated the belief in an autocrasy or reactive force of the organism, which is always in conflict with disease, and how the division of the whole image of disease (*krankheits bildes*) into symptoms of the disease and symptoms of reaction, originated and was perfected. There were always present symptoms of a momentary, often only apparently excited function, which were explained as phenomena of reaction, because under the name of disease they wished to understand mere debility. Thus, inflammation was considered as a reaction against a local irritant, because its symptoms have some resemblance to those of an advanced plastic process. It was expected that the humors would hasten to remove the noxious potency, or to restore the integrity of an injured part; the body should form pus, in order to circumscribe a heterogeneous invader and limit its effect. So long as they saw in congestion an augmented afflux of the blood, whether from increased activity of the arteries or by the spontaneous motion of the blood itself, so long was this mode of expression only allegorical; now, as nothing but a retarding of the motion of the blood is seen in congestion, now it is incorrect. Inflammation is not explained, if in the explanation anything else is presupposed except an organic matter primarily operating in equal regularity, but possessing the capacity of being changed by physical and chemical agents. The result of such a change of organic matter is at one time an exaltation, at another a depression of its functions, in the same manner as a flame becomes more brilliant by this excitant, more dull by that. If the function is depressed by an influence from without, no one hesitates to consider the paralysis as the immediate consequence of an

alteration of the organic matter; but if the function seems exalted, then the excitement will oppose the alteration. It is cause and effect which are striving with each other, and we are assured that, under favorable circumstances, the cause will be subdued by the effect.

I may here appropriately refer to what I remarked before concerning the idea of irritation and reaction in general. Excitement is not the work of an organic autocrat, it is the direct result of irritation, that is, of change of the living substance; it is also destructive, because it consumes vital force. To demand the support and advancement of these efforts of reaction, in order thereby to promote the crisis, is an expedient, against which theoretically we could not be strenuous enough, had not experience herein already outgrown the school, and on its own way arrived at the rejection of that method of cure. But a genuine theory has not generally to inquire, what the critical excitement or efforts strive against, but whence they originate. This question, as well as that concerning the true signification of the critical secretions, when such happen, shall now be discussed more in detail.

I. What are the *molimina critica?*

Of these we may distinguish two principal classes:

1. The morbid process increases in intensity until the vital force is exhausted, or one of the above-mentioned terminations ensues. The symptoms of increased violence must necessarily precede the termination, and as fever generally appears in paroxysms, or at least remits and exacerbates at definite times, so the morbid symptoms do not gradually and steadily increase, but after intermissions or remissions the paroxysms appear always more violent until the last. The critical exacerbation is therefore, only the last and most violent exacerbation of the disease itself. Herein again, two things are possible: either the excitement itself directly brings about the favorable turn, as in the crises by antagonism, by hemorrhage, by sleep, or it is only sympathetic, a symptom of the vigor of the disease, which contains within itself alone the cause of its critical turn (fever, delirium in inflammation). But for that matter, the symptoms of critical

excitement, are also quite as much the symptoms of an impending fatal termination, and all practitioners agree that the only certain criterion, as to whether an exacerbation is critical or not, is whether convalescence follows it or not. The highest degree of excitement in the vascular system, allows us to presuppose that hemorrhage somewhere must follow. This is exacerbation in general. If hemorrhages commence from the capillary vessels of the nose, the rectum, &c., recovery ensues, the exacerbation was therefore critical. If the blood is effused into the brain, the lungs, then death or another disease ensues, the exacerbation was therefore symptomatic. Take another case: a mechanical or spasmodic stricture of the intestine is the cause of an accumulation of its contents above the constricted point, therefore of dilatation, pain, colic, finally of inflammation of the intestine in the vicinity of the stricture. The accumulation of the contents of the bowels, and the inflammation go on progressively, they reach their highest degree, they cause general excitement, fever, delirium,—short exacerbation. Now is the moment in which, either the dilated intestine becomes paralysed, mortified, or bursts, and death follows, in which case the *exacerbation was symptomatic*, or the spasmodic contraction finally overcomes the obstacle, or in the general depression the local spasmodic contraction also relaxes; the intestine becomes pervious again, the accumulated contents are evacuated, and the symptoms excited by them disappear; the *exacerbation was critical*, in this case even the cause of recovery. First, flatus passes down, then follow stools, and the fæces which have been retained days and weeks are gelatinous, decomposed in the highest degree, swarming with infusoria. Those who believe in the doctrine of crises call this a critical evacuation. Their explanation of the case is this: We have an inflammation of the intestine before us, the organism reacts against the morbid process, therefore excitement, finally it overcomes it; the disease forms its crisis by an entirely peculiar kind of secretion, fetid evacuations.

2. The critical exacerbation shows that a change has taken place in the morbid process, which may lead to recovery. This case is distinguished from the above-mentioned by the fact, that

the exacerbation commences suddenly with new symptoms, and that these, even if the disease previously seemed mild, reach a dangerous height, or, what is particularly delusive, if the disease was previously local, manifest a general participation of the whole collective organism.

A *furunculus* manifests itself by local tumefaction, redness, pain, &c. Fever is absent or is slight, the pulse very little accelerated, heat slightly augmented. The patient, hardly considering himself sick, is suddenly seized with chills in the evening, unusual heat follows, with loss of appetite, thirst, debility, &c. These symptoms also continue for some time according to the violence of the disease, the tongue appears coated, and headache supervenes. The next morning, or after some days, the patient observes an ulcerated point upon the summit of the furunculus, this opens or is opened. The process of ulceration goes on not only without general symptoms, but almost without local symptoms, and if we did not see it, and by contact could not excite pain in it, the entire morbid process would seem to us as terminated with the fever, and with the first copious discharge of pus. This fever, which accompanies the transition of inflammation into suppuration, is called suppurative fever. Now can we in earnest imagine, that the sensation of increased heat in the cutaneous nerves, or the accelerated motion of the heart, or the headache, could change the serum of the blood there effused in the furuncle into pus? If we will not adopt the opinion that pus is formed in the blood, and is only deposited in the inflamed spot, which is very improbable, the general symptoms mentioned can only be derived from a change which the nerves or the blood experience in the local seat of the inflammation, and by the introduction of suppuration. These facts will be again discussed in a latter part of this work, in connexion with others related to them.

Now, if internal inflammations are the causes of a so-called general disease, and are overlooked because the characteristic symptoms, often the pain itself, are wanting; if these inflammations go on into suppuration, and are thereby terminated, then we may very readily come to the conclusion, that the suppura-

tion accompanying fever, which is only one of its symptoms, is the prognostication, ay, even the cause of the termination of the disease.

But even the suppurative fever is not always critical, that is, the antecedent of a favorable termination. If pus is formed upon membranes, and is effused into cavities from which it can be discharged, then follows recovery, and the *exacerbation was critical.* If pus is deposited in the substance of noble organs, then follows chronic disease, or death, and the *exacerbation was symptomatic.* In fact, the suppurative fever itself may become fatal by its own violence, or if the blood becomes so much changed that nutrition of the central organs suffers more than is compatible with life, then, says the mythos, nature is overcome by the critical effort.

II. What signification have the critical secretions?

1. The critical secretions are actually critical in some cases, where the secretion, even excited by the disease itself, and not by the sanative power of nature, is still effective towards recovery. The secreted matter may actually have been the cause of the disease, or of many morbid phenomena; for example, in critical hemorrhages, or when, in general diseases of the blood, the matters formed in it (lithic acid, bile pigment) occasion the pathological phenomena. Also, if the disease originates from the suppression of a secretion, when it appears again this secretion is critical. Finally, in the cases adduced, where a disease terminated by communicating excitement to a secreting organ, and by the secretion the blood was attracted to the irritated part, the secretion was, also, critical. So is perspiration critical in cutaneous congestions; so is salivation in congestions of the head, and particularly of the brain, &c.

2. A matter secreted during disease, and accumulated by means of the same, is evacuated after the disease has ceased; for instance, fæces after enteritis, during which constipation, or merely a watery diarrhœa from the large intestines, took place.

3. The secretion of a critical matter is a pathognomonic symp-

tom of the last stage of a disease. To this class belong the purulent exudations upon internal membranes, after inflammation of these membranes (although no one considers the external, visible pus as critical, but only as a morbid product): the disease, it is true, does not terminate with the appearance of the exudation, but the latter is often its general symptom. Moreover, to this class also belong the exfoliated epidermis and epithelium of mucous membranes, as they appear in the stage of desquamation of many exanthems; for instance, as catarrhal sputa, or as mucous sediment, with the urine, are secreted. But these matters, also, are considered as critical only in internal diseases; the desquamation of the cuticle, after scarlatina, erysipelas, &c., generally obtain as the result, not as the crisis of the disease.

4. The critical discharge is a symptom of returning activity in organs, whose function has been suppressed by general or local causes. If, during the progress of a disease, on account of the abnormal quality of the blood, or on account of sympathetic affection of the nervous system, the organs of secretion also suspend their function, then, at the termination of the disease, with the normal sensation, with the appetite,—in short, with the general symptoms of healthy life, returns also the function of the glands: the result of this is secretion. If the pulse, which has hitherto been spasmodically tense, becomes soft and undulating, we have reason to suppose that this expansion, favoring the flow of blood and secretion, will be extended to the capillary vessels: therefore, this change of the pulse is a symptom of the impending crisis. The secretions will certainly be more abundant in the usual excrementitious matters than in others. But the excretion is not the cause of the termination of the disease, but the consequence. In fevers, the function of the sexual organs also ceases. If, after recovery, a copious pollution takes place, no one will assert that the excretion or pollution was critical. Such excretions, if they are critical, that is, if they indicate the termination of disease, must contain the normal excrementitious matters, perhaps in greater quantity; and, in this very fact, we

have the means of distinguishing critical excretions from the symptomatic.

5. The excretion is accidentally changed by antagonism. After copious sweats, the watery contents of the urine are diminished, the quantity of salts is relatively augmented, and, on this account, the urine may retain the latter without their being dissolved by cooling. He who seeks for critical matter, may see it even in such urine. He finds it after every considerable sweat in fevers. But I can certify, that the urine appears in every way quite as critical, after every violent motion whereby the body is thrown into a perspiration, for example, after a night spent in dancing, or after remaining a long time in a very warm room, as after a paroxysm of intermittent fever. I have mentioned above, that many paroxysms of fever terminate without any urinary sediment; and I think it will be found, by a little attentive observation, that the urinary sediment is in more direct proportion to the intensity of the sweating-stage of fever; a conjecture to which Andral also inclines. From a like cause, the copious symptomatic urinary sediments, together with abundant symptomatic sweats, occur in rheumatic fevers. We are, in general, cautioned against attributing a critical signification to the urine, whose watery portion is accidentally increased by spirituous drinks (*urina potus*). But we should assign quite as little value to the urine, from which water has accidentally been abstracted by diaphoresis.

6. According to Becquerel, an unusual quantity of lithic acid sometimes appears for several days in the urine of persons who suddenly exchange a spare diet for a stimulating one, containing azote. Reconvalescents are not unfrequently so affected; and in this way, possibly, are many of the urinary crises excited, which are only observed after recovery.

7. In conclusion, I cannot omit all mention of the crises which are artificially made. Remedies promoting secretion often refuse to perform their service during disease, as, a blister-plaster may not even redden the skin in asthenic fevers, but the inflammation therefrom follows only by way of supplement at the end of the disease. So we make crises by purga-

tives, diaphoretics, &c., as remedies, which, although insufficient during the progress of disease, yet manifest their effect at its termination. A plentiful source of mistakes, and one that has hitherto remained almost entirely unobserved, lies in the property of vegetable-acid alkalies to make the urine alkaline and turbid. According to A. Krukenberg, partaking of a few spoonfuls of apple-sauce, or of a few plums, is sufficient to communicate the above-mentioned property to the urine. What, therefore, can we expect to accomplish with the statistical reports of disease, where a turbid appearance of the urine, often no more particularly characterized, is registered, without specification of the medicaments given or the diet?

If, now, an adherent of the orthodox medicine, in order to oppose the bold deniers of the doctrine of crises, refers to the recoveries, and their fœtid skin or sedimentous urine, he makes use of a species of argumentation very similar to that by which, for ages, the conjurors have maintained a belief in their art. That a devil has been expelled, would be proved by the evil odor left behind by him. The fœtor was a matter of fact; that it could have been prepared in no other way than by the devil, that—is a matter of course. But, by the by, the orthodox physician must also be informed that the prophesied phenomenon sometimes fails; and when the urine does not exhibit the critical matter, he must have the daring to assert that it may have flown off through the skin.

If the expression *critical*, *decisive*, will be retained for certain morbid symptoms, which prognosticate or indicate recovery, then, except in those few cases where it is appropriate, let it be done at least without the active concomitant signification, which the usage of language or custom has connected with these words. A critical secretion is certainly nothing else than one belonging to the stage of crisis.

B. TRANSLATION INTO ANOTHER DISEASE.

METASCHEMATISM—METASTASIS.

A disease, which passes into another, changes the form or the locality.

In reference to the change of form (metaschematism), various distinctions have been made, as, for instance, the metamorphosis of acute into chronic diseases, the change of one general disease into another, of one local disease into another, &c. What has been, and can be said on this subject, is worth nothing, unless we at the same time have regard to the cause of the disease. If one complex of symptoms, in consequence of new causes, is changed into another, it is evidently only by a figure of speech that we can call this a translation of the one disease into the other, and to be understood somewhat in the same way, as when we speak of a change of love into hate, when hate appears *instead* of love. But if the second disease is developed out of the first, without any new influence; as, for example, if gastric fever becomes nervous, a congestion becomes inflammation,—then are both only stages of one and the same process, and it were improper to separate them from each other under specific designations.

The change of locality of a disease is called metastasis; the disease which secondarily arises in consequence of this change, is called metastatic.

The idea of metastasis, like the notion of crisis, first originated in the mythical humoral pathology: the two are nearly related to each other. In both processes, according to the opinions of the school, a change of the morbid matter takes place. In the crisis, this matter is secreted by an organ, without the organ itself becoming diseased; in metastasis, it throws itself upon an organ, and produces disease in it, but a disease which is sometimes wholesome, and then is called critical. Translation of a disease from within outwardly, to the advantage of the affected part, is therefore also called a crisis (critical exanthem); transposition of a disease from without inwardly, to the detriment of

the patient, is metastasis in a limited sense (small-pox metastasis). In many fevers, congestions to the skin or to the salivary glands occur; and, in consequence of these, either increased secretion, or, if the exudation effuses in the one case under the epidermis, in the other into the interlobular cellular tissue, eruptions and swelling of the parotid glands. The former secretions are designated as critical; the latter exudations as metastatic.

In the ancient humoral theory, the wanderer was a matter, which, by its influence, should excite the tissues, in themselves healthy, to abnormal activity. If its deposit or development in one locality is accidentally or designedly hindered, it throws itself upon another, as they represented. The doctrine of parasites, and the popular ontological opinions, put the disease itself in the place of the materia peccans, and allowed this to disappear and reappear. The more modern humoral-pathological schools have finally returned to their former conceptions; only that they, in accordance with the amplification of chemical and physiological knowledge, seek more exactly to establish the nature of this wandering matter, and the course which it takes in its ramblings. In reference to the former, they have advanced hardly farther than to hypothesis. With regard to the way in which metastasis takes place, they are tolerably uniform in the opinion, that the blood-vessels or lymphatics absorb and deposit the pathic matters. If a general disease becomes a local one, then the blood has deposited, in a particular organ, the matter which has hitherto corrupted it. If a local disease becomes a general one, the blood has attracted or drawn out the matter from the particular organ: still, this transition of morbid matter from the tissues into the blood, is not usually called metastasis, but "sympathy of the collective organism." They believed that experience had taught, that nature designed single organs, par excellence, for the secretion of definite morbid irritants; for example, the great toe for the matter of gout, the veins of the rectum for the morbid product in hemorrhoidal diseases: and they also reckoned among the metastases those morbid processes which arise from the original deposit of products

in unusual places. Here, the metastatic disease appears to be *vicarious;* not *after*, but *in place* of the primary disease.

According to this modern shape which the idea of metastasis has assumed, it includes two things: first, a determination concerning the internal connexion of diseases; then, a surreptitious explanation of this connexion. In respect to the first, it demands, that the disease which shall be recognised as a metastasis, shall be the consequence of the cessation or nonappearance of another. In regard to the latter, it maintains, that that which in one place recedes and breaks out in another, is one of the component ingredients of the blood. In the application of that idea, there has been a twofold mistake: 1st, that causal connexion has often been too thoughtlessly presupposed, and every *second* disease has, without reflection, been considered as *secondary;* 2d, by means of that principle of explanation, a great number of hypothetical morbid matters have been furnished, and the multiplicity of means, by which the anomalous activity may transfer itself from one organ to another, has been overlooked. In both respects, therefore, it is necessary to make some limitations.

In the first place, we must strike out of the series of metastases those cases in which the supposed causal connexion does not really exist; and the disease, erroneously considered as metastatic, does not commence *on account* of the termination of the first.

In the second place, among the metastases are included certain processes, in which the objective matter of fact does not at all justify such an adoption; where, namely, the symptoms of the old affection continue, together with those of the new. We hear of metastases of gonorrhœa to the testicles, even during the continuance of the gonorrhœal discharge, when inflammation of the testes appears, often remains unchanged, and frequently, indeed, is increased. It is quite as little a metastasis, when gonorrhœal ophthalmia takes place during the course of a gonorrhœa, which certainly happens for the most part accidentally, by external transference of the gonorrhœal mucus to the eyes, or,

when a parasitic tumor transplants itself internally along the veins and absorbents.

In other cases, it is true, the course of the symptoms does not directly contradict the suspicion of a transposition of disease, but yet it leaves room for explanations of another sort. The following illusions are possible:—

1. The old and new disease stand in no relation at all to each other, and their connexion exists only in the brain of the theorist. To this class belong the much-renowned itch-metastases. The belief in these was for a long time shaken by the misuse which was made of them. As on the one hand, all possible cases were attributed to so extensive a disease as the common cause, regardless whether it had been removed rapidly or slowly, whether weeks or years had elapsed since its disappearance, in fact, even upon the mere conjecture that an individual must have been afflicted with it some time or other; so, on the other hand, it must be confessed, that under such circumstances, no proof at all could be adduced, and that to any objection, the ever-increasing number of examples where the itch had been cured without special precaution and without detriment, could be placed in the balance as a counterpoise. By the discovery of the "acarus scabici," all dread of the reappearance of the psoric acrimony has become completely ridiculous. After suitable treatment of the itch, the acarus not only shows very little disposition to translation to internal parts, but it is actually killed by the medicaments which are used as remedies for the itch; it is capable of doing to the body which it infests precisely as much injury as an expelled tape-worm, and no more. But the inflammation which is excited by it, like a traumatic inflammation, has no disposition or aptitude for transposing itself. At best, it should only be regarded when it has continued for a long time, somewhat in the same light as we look upon an old issue or a fistula; that is, we should consider whether, in an abnormal morbid predisposition, it may not be doing great service as a derivative.

2. The old and new disease have a common cause; and this cause is a general affection, whose nature is to attack different

parts of the body in succession. This is the case with the wandering erysipelas, with acute rheumatism, with the dropsy in Bright's disease of the kidney. Here, no particular influences are necessary in order to drive the morbid process from one organ to another; although, from this predisposition to wandering, an actual metastasis must be much easier accomplished.

3. The appearance of the second disease, occasioned by the first or by new causes, is attributed to the cessation of the first. As a critical signification is ascribed to the cutaneous inflammation in miasmatic contagious diseases, so is each complicated or severe internal affection which appears in the course of the same, and is attended with delitescence of the eruption, attributed to the retrocession of the latter. But, *vice versa*, the violence of the fever, the corruption of the blood with pus and other things, or an important internal disease appearing as a complication, may produce a condition of general asthenia, which renders the carrying on of the local morbid process impossible; in the same manner as vesicants and other inflammatory irritants are followed by no reaction, and suppurating wounds cease to form their secretion when the nervous power is exhausted.

Having thus set apart these pseudo-metastases, we are now to enumerate the means whereby genuine metastases are accomplished; that is, whereby the interruption of certain morbid processes gives occasion to the development of morbid vital indications in other places.

1. As I have mentioned in a former place, there is an *apparent* sympathetic extension of morbid activity, arising from an extension of the morbific cause. Thus, for instance, the extension of the psoric eruption is, at least in part, occasioned by the wandering of the parasite which produces it. Let us, for a while, allow the hypothesis, that the contagium of acute exanthems is a similar organic morbific irritant, which, from the surfaces of mucous membranes, upon which it is generally first received, spreads over the external surface of the body, and marks out its passage by the exanthem which it excites. This being allowed, conditions or circumstances are imaginable, which, by hindering its progress in one direction, promote its extension

in another; in the same manner as a plant, deprived of the air and light on one side, developes itself pre-eminently on the opposite side; or as an intestinal worm, which has been expelled from the bowel, and escapes somewhere in the hepatic duct, would occasion a change of the symptoms of enteritis into symptoms of irritation of the liver; so may a parasite, which is the cause of contagious disease, grow in depth from the place of its admission, if it does not find the conditions of its existence in the external skin. This certainly might be the case, where the skin becomes contracted, and the exudation from its vessels limited by cold, whilst a systematic and general chilling through of the organism seems principally to limit the development of the parasite. Perhaps, on this account, the exanthems which are inoculated in the skin, particularly variola and varicella, are so much less pernicious and malignant when they extend over the entire cutaneous surface, and are accompanied with violent fever, because the exanthem in a less degree affects the internal membranes. Even the vaccine disease, after the inoculation and during the tumefaction and ulceration of the inoculated pustule, sometimes runs its course without any considerable fever. Measles inoculated directly into the epidermis, and other external eruptions, may excite tears and sneezing; but they are less apt to excite cough and inflammation of the eyes, than after accidental infection. Home, who made the greatest number of experiments with inoculation, ascribes its usually mild course to the fact, that infection does not take place through the agency of the lungs.

2. In the connexion of neighboring vessels by anastomosis and plexus, the vacillations to which the mass of blood to one part is subjected, must reflect back, in a pure mechanical way, upon the adjacent organs. Let us take the most simple case, where a lateral branch derives a certain quantity of blood from the main trunk; then must the resistance, and, because the arteries are elastic, the pressure of the blood in the trunk be increased, if the lateral branch is closed up, or is only constricted at its points of exit from the trunk. If that branch was abnormally dilated before, then its return to normality, and with it

the termination of a morbid condition, may cause the pressure of blood in the trunk to exceed its previous degree. The more the morbid action had become a habit, and the more rapidly it is overcome, so much more perceptible will be the reflex pressure. But the consequences of this reflex action we can correctly estimate, only when we at the same time measure the forces with which nature has endowed the vascular system for resistance against the pressure of blood. The less, by virtue of their tone and elasticity, is the pliability of the vascular walls, the greater is the tendency of the increased pressure of blood to produce, instead of a dilatation of the vessels, only an acceleration of the circulation, which is, for the most part, without objective symptoms. If the blood comes with its accelerated velocity and force from wider canals into narrower ones, and finally into those that admit of exudation, then, by increase of the latter, the whole evil may be compensated without further detriment, provided that the exudation does not become so great as to occasion congestion. The appearance of a secretion, or even of a hemorrhage, would afford the most natural remedial assistance in this case. Upon these grounds, it appears to me, the fact is to be explained, that disturbances in the arterial circulation, as, for instance, by the application of a ligature to a main trunk, only seldom have any apparent effect upon the organism, except the gradual dilatation of the collateral vessels, and that arterial congestions come and go, without manifesting any influence upon the neighboring parts, where particular sympathies are not called into play. The arteries must be contracted to a very much greater extent, as is the case in the chills of intermittent fever, and in higher degrees of and longer continued cold, before the repletion of another circuit of the vascular system is perceptible. Not so the veins: their thin walls are not capable of resisting a violent pressure of blood; no natural exudation frees them from the pressure to which they are once exposed; besides, they seem to share the peculiarity of many structures formed of cellular tissue, which, when once forcibly expanded, only with great difficulty regain their natural tone. Finally, in the plexuses in which all parts of the venous system are so abundant, there is a

means whereby, indeed, obstructions of the circulation, on the one hand, are more readily overcome, but their consequences, on the other hand, are further extended. What, now, would be the consequence, if the veins, which, by stenosis or obliteration of anastomatic branches, are forced to receive more blood, are so situated that a slight dilatation of them has a perceptible effect upon important organs?

These remarks apply particularly to the familiar, but unintelligible relation, in which hemorrhoidal congestion stands to the various diseases of internal organs. The hemorrhoidal veins, like the veins of the pelvis generally, are connected, on the one side, with the veins of the abdominal viscera, and, on the other, they proceed through the vena cava, the lumbar veins, and the venous plexuses which surround the nervous trunks in the intervertebral foramina, into the venous plexus of the vertebral cavity. The venous blood of the lower part of the body may ascend through the mesenteric veins, or through the vena cava to the heart, and is distributed in both ways, according to the calibre of the vessels. If the tone of the veins generally is diminished, which condition is denoted by the term increased venosity, and an unusual dilatation is therefore possible, then it may be of essential service to the spinal marrow and nerves, if the flow of blood towards the mesenteric veins is promoted by pre-eminent dilatation of the branches leading in that direction; and vice versa the spinal marrow and nerves will have to suffer so much more, the more the intestinal veins preserve their tone. Here is not the place further to pursue this subject: I wish only to show that the uses of hemorrhoids, and the danger of their cessation or disappearance, do not necessarily urge us to the adoption, that the hemorrhoidal veins are obliged to secrete a matter which may be transferred to other organs, and which must be derived back again to the rectum, before those organs can be relieved.

3. If the pressure of blood may prove injurious from the fact of its forsaking its usual course and striking out a new direction, so much more considerable dangers must arise, if in this new direction, it also at the same time loses in mass. This is the

case with flowing hemorrhoids, and many other morbid habitual hemorrhages and secretions. Their suppression, like the suppression of menstruation, may be accompanied by many kinds of detriment, even when only the normal ingredients of the blood are thereby retained. This differs from the preceding case, in that not merely the neighboring parts are affected by the new distribution of the blood, but each organ, and particularly the one pre-eminently irritable, may have to suffer from the relatively augmented plethora.

4. Every kind of sympathy and antagonism gives occasion to metastases, as I have mentioned several times in the paragraphs on these subjects. The sympathy between the parotid gland and the testicles, uterus and mammæ, is, as it were, principally inferred from the metastases which happen in diseases from one of these organs to the other. Many examples were adduced of the alternation of different nervous affections, and of metastases of external inflammations to organs situated in internal cavities. The fact that matter destined for excretion is retained in the blood, by arrest of function of the usual secreting organ, and may then be translated to another organ to whose tissue it has a particular affinity, should be referred, for its explanation, to the normal and abnormal ingredients of the blood. I ought here however to mention those suspicious events, till now almost inexplicable, which take place after the suppression of hepatic eruptions and foot-sweats, after the cure of atonic ulcers of the feet, and fistulas of the rectum, &c. The secretions which are furnished by the diseased surfaces are, for the most part, too inconsiderable, and the consecutive processes (most frequently tuberculosis of the lungs) are of a too peculiarly dyscrasic nature, to admit of our deriving the latter from the augmentation of the blood mass alone, that is, from the cessation of diminution of the mass of blood. Here we cannot help thinking of the retention of a pathic matter destructive to the organism, notwithstanding the attempts to demonstrate such a one have always been so fruitless. But still there is much to be advanced in support of the opinion, that, even in these cases,

only such organs are affected as have a morbid disposition already present in them.

5. In the whole series of metastases hitherto enumerated, we have not yet found one which perfectly corresponds with the definition which is given by humoral pathology. The common definition everywhere is, indeed, a transilience of the morbific process; but nowhere does this take place in such manner that the vessels transport an already deposited morbid product from one place to another. I will not conclusively deny the possibility of such an event, although it seems actually to occur only under very unfrequent circumstances. Something similar, unless it be called a direct removal of the disease, takes place in the cure of dropsies by bloodletting, by diaphoretic, diuretic, or aperient remedies. In this case, in fact, it is the lymphatic or absorbent vessels which take up the water from the serous cavities, after it has been effused into them from the blood-vessels, and in order to restore their normal condition. Perhaps a portion of the so-called metastases of pus belong to this class; I mean those cases where great collections of pus—unopened abscesses—suddenly collapse, and then either a sediment appears in the urine, or purulent effusions in serous cavities, or more copious expectoration from the lungs takes place. In every case, of course, only the plasma of pus could be absorbed and then again secreted. In the one case, the corpuscles must be retained; in the other they must be newly formed. I shall return to this subject in discussing the terminations of inflammation.

In a more improper and unwarrantable manner, cases are adduced as belonging to the class of metastatic diseases, which arise when a normal secretion is not perfectly accomplished, or is suppressed. We hear of transposition or metastasis of the milk, of the lochia, and even of the bile, and others. These phenomena, which do not belong to the terminations of diseases, will be mentioned in the special part of this work.

III. TERMINATION IN DEATH.

The vital duration of the organism and of its elementary parts, cannot be artificially prolonged, although it certainly can be artificially abbreviated.

Death, which occurs within the typical vital limit of organic bodies, should naturally and necessarily be considered *normal.* It takes place at the extremest age, without preceding disease, —without any demonstrable, special cause of dissolution,— gently and gradually, or rapidly, perceptibly, and with full consciousness, or imperceptibly in sleep, and in all parts simultaneously.

Every kind of death, which depends upon any other cause than the typical termination of the individual vital process, is unnatural or violent, unless the usage of language restricts this signification to those cases of death which proceed from rapidly operating, or particularly remarkable, or voluntarily introduced influences. In contradistinction to necessary, normal, or generic death, we may distinguish the accidental or abnormal death.

Of course, according to the intensity with which a noxious potency operates, it causes death suddenly or slowly. In the latter case, death concludes a series of functional disturbances— the disease, or it is the termination of a disease. The common people may consider death by poison, carbonic acid, hunger, or cold, &c., in contradistinction to the death by disease; but, according to our stand-points, the events which in those cases precede death, *are* diseases; and even in the properly so-called diseases, it is not the disease which kills, but the morbific cause.

Death is the cessation of the reciprocal change of matter; its characteristic sign is definite cessation of function. If the function of an organ is very important, we soon perceive its death: in the opposite case, death of a part may long remain concealed. When the hair dies in typhus, it is only perceived after reconvalescence, and from the fact of its falling out: death of the brain makes itself known instantly.

We are accustomed, in the definition of death, to include or associate in our minds one of its results, namely, that dead parts

are immediately subjected to the chemical forces of matter, or are decomposed into more simple combinations, in conformity with their chemical affinities. This is only half correct. I will not deny, that a material difference exists between a living tissue and one recently destroyed; but there are tissues which, although separated from the mother organism, and incapable of further organic development, still are no further changed even chemically: for example, the horny structures, the teeth, bones, &c., and every soft structure even, may be preserved in the form and combination which it gained by means of the vital process, if it is protected from the causes of decay, fermentation, or putrefaction. The mere cessation of life is not alone sufficient to unloose the band which held together the elements in the complex atoms of the body. Some other impulse from without is required to effect this, such as heat, fermentation, &c. But, as in the rule, there is no lack of such impulses or incentives, chemical decomposition is a good, perhaps the only sure sign, that life is irretrievably extinct; but it is neither a constant nor even the peculiarly essential characteristic mark of death.

All possible cases of accidental death, as well of the entire organism as of individual organs, may be comprehended under the two following classes:—

1. Deficiency in the vital irritants. For the whole collective organism, these are, nutrition, oxygen, and caloric. These are supplied to each individual organ by the blood. According to the genus and the age of the individual, and according to the nature of the particular tissue, abstraction of the vital irritants causes death more rapidly or more slowly.

2. Alteration of organic substance, by physical and chemical influences, whereby it becomes incapable of its typical reception of the vital irritants.

Death, like disease, may be general and local. It is general, when the destroying force affects all parts at the same time. Thus, electricity, prussic acid, &c., annihilates irritability in all structures simultaneously, as far as their irritability may be determined. Local death is the result of the local operation of the morbific potency or of a local disease. We call it mortification,

when those chemical changes of matter take place which indubitably announce the actual appearance of death. But even here, the putrefaction is only the consequence of death; and, after local death, this may the more readily fail of making its appearance, as every part of the body is not in that condition which is favorable to the commencement of corruption. Nervous filaments, whose communication with the central organs is cut off, which have lost their irritability, and in which, as it were, the medullary substance seems coagulated, as in exsected nerves, might well be considered as dead; but yet they seem to be capable of being preserved in this condition, as long as the body generally continues unimpaired in its vital functions.

Local death—even a loss of function, occasioned by previous circumstances, in those organs by whose action the vital irritants are conveyed to the rest, is necessarily followed by general death. Such organs are called the *atria mortis:* they are the heart, the lungs, and the brain, or, more strictly speaking, the medulla oblongata; because, destruction of the other parts of the brain, destroys only consciousness and the motion of many, not the vitality of all parts of the body. The heart, the lungs, and medulla oblongata, stand in a peculiar reciprocal relation: each sends to the other, and receives from it the conditions of its vital manifestations. Innervation of the muscles of respiration depends upon the medulla oblongata, the energy of the medulla oblongata upon the decarbonization of the blood, in the accomplishment of which the circulation and respiration must unite. The force of the heart, if not directly, yet indirectly is connected with the medulla oblongata, because venous blood is not capable of preserving the irritability of the muscles. So the failure of any one of the three links in this chain, is fatal. From which of these death primarily proceeds, is not to be determined with equal certainty in every individual case; but theoretically, we may distinguish death by paralysis of the heart (*per syncopen*); death by closure or constriction of the air-passages (*per suffocationem*); and death by paralysis of the brain (improperly called *Mors per apoplexiam*).

From these considerations, we may conclude under what circumstances morbid processes, earlier or later, lead to death.

1. If they occasion a sudden, copious loss of blood, or a continued loss of the humors, which exceeds all possible compensation or restitution. In this manner all diseases cause death, in whose train of sequences appear hemorrhages, fungi-hæmatodes, uterine polypi, &c.; so, also, those diseases which occasion more copious and profuse exudation of the blood plasma, extensive ulcerations, Bright's disease, and others.

2. If they prevent the reception and preparation of the means of compensation or recuperation. This happens in the various disorganizations and paralyses of the organs of respiration and digestion.

3. If they cause the blood to become impregnated with matters which render it unfit for the purposes of nutrition; either,

a. Directly, by admixture of pus, gangrenous ichor, &c.; or,

b. Indirectly, by preventing the excretion of those products of decomposition from which the blood should be freed.

Liver and kidney affections, obstruction of the biliary and urinary passages, perhaps also extensive or general interruption of cutaneous transpiration, become fatal in this manner.

4. Every process, whereby the collective nervous power, or, in particular, the energy and vigor of the medulla oblongata becomes exhausted, is fatal; every complete and total depression; every excessive irritation, leading to paralysis, as in tetanus and in many nervous fevers; every local anomaly of the motion of the blood, and every structural change which destroys the function of the medulla oblongata.

5. Every disease of the heart, which leads to paralysis or rupture of this organ, or only mechanically renders the regurgitation of venous blood for a time impossible, is fatal.

6. Diseases of the thorax and of the diaphragm, which prevent the natural expansion of the thoracic cavity, terminate fatally; so, also, diseases of the chest, which, like hydrothorax, empyema, &c., compress both lungs from without: finally, diseases of the lungs, which destroy either the capability of expan-

sion of the bronchia, or their ability to contract, or lead to effusions in the same.

Where the transition from life to death is not completely instantaneous, as is the case perhaps only in the death by lightning, and from crushing and lacerating mechanical forces, certain signs precede the event of death, which announce its approach. The stage in which these signs occur is called agony, death-struggle; it is called a struggle, because it happens associated with symptoms of excitement, particularly convulsions and pains, which poetically may be considered as a resistance or striving against annihilation. Only in the case of death by suffocation, are the motions primary and truc instinctive struggles, which aim at the preservation of life; but convulsions are symptoms of irritation, which must be explained from a secondary effect of the proximate cause of death upon the central organs, and which only happen in those particular cases wherc the cause of death has this secondary effect. These convulsions stand in no relation to the force of reaction or to the vital force, because, in the most vigorous persons who are seized with apoplexy, a condition of coma may altogether imperceptibly pass over into death; whilst there are emaciated and feeble patients, wasted by phthisis, who struggle for hours and days between life and death, writhing with convulsions and pain.

In every individual case, the phenomena of agony are made up of the specific symptoms of the disease, which puts an end to life, and of the symptoms of commencing and always progressively increasing paralysis of the nervous system and of the muscles. The paralyses, which appeared during the course of the disease, continue; the symptoms of excitement, by which the diseasc was accompanied, gradually disappear. Thus it may happen, that shortly bcfore death the normal energies rcturn in those organs, in which it was suppressed during the disease by sympathetic excitation. Not unfrequently are the last moments of the dying brightened by the return of consciousness, when, until that time, they had laid senseless and in delirium; yea, the sudden transition from the oppressive spasms of the heart and of the viscera to a state of repose, may produce a physical com-

fort and psychical ecstasy, which reconciles the sufferer by appeasing the terrors of death, and has not a little contributed to fix the easily-diverted thoughts upon the release, from its earthly bands, of a soul destined for freedom.

But the paralysis of agony is less than repose; it is loss of tone, which the muscles otherwise retain also in repose—even in sleep and in syncope; it extends to structures which, during life, are allowed only momentary intermissions.

Unless a common, simultaneously-paralysing cause, operates upon the entire nervous system, the different apparatuses die in a definite, tolerably regular succession. If the consciousness has not been previously disturbed, it survives the senses; the sense of sight first becomes extinct, and the dying cry for light; they still give signs of intelligence, with regard to impressions on the sense of hearing, after the eye has become shrouded in darkness; they feel the coldness which creeps over the body from within outwards. Of the muscles, the external first lose the faculty of answering the will; their motions become tremulous, their convulsions feeble; unable to overcome the weight of the different parts of the body, they express themselves merely in twitching of the tendons. Soon the tone also vanishes; the body slides downwards in the bed, the limbs follow the direction which gravity gives them, the features become relaxed and drooping, the lower jaw falls down, the eyelids sink without closing, the eyeball is no longer fixed, but retreats in its socket; respiration becomes slow and laborious, and when, in the last stage, the bronchia are filled with fluid, the breathing is rattling; the œsophagus is dilated, and allows whatever is poured into the mouth to drop down into the cavity of the stomach with a rumbling noise; the sphincters have very little power of resistance, and are overcome by the muscles of the bowels, which are still relatively powerful. In the same relative manner, the impulse of the heart becomes inadequate to propel the blood against the slowly vanishing tone of the arteries. The pulse, which, in the beginning of this stage, still corresponded to the feeble and innumerable beats of the heart, now does not extend to the external parts of the body, and finally also ceases

in the trunks of the arterial system. From this contraction of the vessels, which the heart can no longer antagonize, the external parts of the body lose their redness and turgescence; the eye becomes dull and lustreless. From the finest capillary vessels and the beginnings of the veins alone, an exudation may possibly still take place, which, on account of the thinness of the walls of these canals, is more albuminous than the usual product of exudation. The viscid, clammy sweat of persons who are dying, gives some ground for this conjecture. Simultaneously with the nervous function, the measurable heat withdraws from the extremities to the trunk.

The combination or coincidence of the changes in the face and eye, which have been mentioned,—the simultaneous loss of tone and turgescence, forms the *facies hippocratica.*

Notwithstanding with the last gasp, life seems to be extinct, still, the irritability of the contractile tissues continues for awhile after. In the thorax, opened immediately after death, we behold the heart still beating; the arteries propel the blood into the veins, before they sleep for ever. Upon opening the abdomen of animals, I have often seen the bowel in motion several hours after death, and once in a rabbit, to my astonishment, even twenty-four hours after death. The varicose muscles are also affected by galvanic irritation a long time after death. The manner of death, and the condition of nutrition of the organs before death, influence the duration of these phenomena of irritability.

As long as these spontaneous or artificially excitable manifestations of activity continue, death is not general, and a general reviviscence or resuscitation is not impossible. Experience even teaches, that the heart of animals after death, yea, the exsected heart, may repeatedly, after long pauses, of its own accord begin again its rhythmical motions, and that the muscles of amputated limbs, notwithstanding they seem exhausted by the irritation, are capable of recovery. If we define death as the final cessation of vital phenomena, then, between the last gasp (the apparent death) and the total and irrevocable extinction of irritability, we must fix a certain interval, during which we are

undecided whether actual death has taken place or not, and during which the return of the organic functions may be looked for, and even, under some circumstances, experiments or attempts must be made to restore them. This is the interval of apparent death, or asphyxia. The duration of this condition, which may pass over either into actual death or into actual life, is variable. The physiological asphyxia, into which many animals, and even some of the higher vertebrated animals, fall during winter, proves, that stoppage of communication with the external vital irritants, is not necessarily followed by decomposition of organic matter. We have authentic accounts of persons who have returned to life after six and seven days apparent death; of others, who lay quite as long, and even longer, in a state of asphyxia, before the unequivocal symptoms of dissolution were apparent. In the rule (as the commencement of mortification shows), the stage of asphyxia or apparent death is of shorter duration.

There is some foundation for the expectation of being able to resuscitate those apparently dead, when a rapidly operating cause of death came in contact with the body in its full force; when it only for a moment mechanically, or, at least, without destruction of organic structure, arrested the function of organs indispensable to life; principally, therefore, in certain sudden and violent modes of death, as from suffocation, drowning, hanging, freezing, apoplexies, &c. In these cases, the means of discriminating between true and apparent death, which I am about to mention, must be applied, at the same time with the therapeutic design of re-establishing the interrupted play of the functions. All expectation of the return of life is entirely to be abandoned (if we except those cases of evident destruction and decomposition of the most noble vital organs), only when the unmistakeable signs of absolute death are present, which I will now enumerate in the order of their succession, proceeding from the more dubious to the more certain.

1. Apparent death may be distinguished from the similar conditions of sleep and swooning, from coma, carus, lethargy, and others, by the deficiency of respiratory motions, and of the mo-

tions of the heart, and by the lack of reflex action, which sometimes may continue even longer than the respiration, and on the contrary, is sometimes absent in deep lethargy. Actual death may be distinguished from apparent death by the complete loss of tone and of irritability. In doubtful cases, therefore, apparent death may be determined by holding a fine feather or the flame of a candle before the nose; by auscultation of the heart, in proper cases by venesection, which gives evidence of the condition of the heart's activity. For the purpose of testing muscular irritability, the direct irritants are first mentioned, particularly electricity, but this is prescribed as an agent which exhausts the least irritability; then we have excitants through the interposition of the sensitive nerves, by strong light and odors, tickling the nose and skin, by burning, sprinkling with cold water, rubbing, &c. Cold, as a means of irritation, that is, applied unexpectedly, rapidly, and at short intervals, and the continued friction of the external parts of the body, operate the most decidedly towards the production of reflex motions: they are, therefore, together with the means indicated by the special cause of death, particularly recommended where experiments are undertaken with the hope of effecting resuscitation. They seem particularly calculated to excite the nerves of respiration, through the spinal marrow, thereby causing an expansion of the thorax, which absorbs the venous blood from the different parts of the brain, and renders the accession of fresh arterial blood possible. Venesection, as well as the artificial restoration of the respiratory motions, by inflating the lungs with air, &c., has the same design, because the renovation of air in the lungs, when the circulation has actually ceased, can do no good to the brain. It is possible that the expansion of the thorax is also useful, by irritating and unloading the heart, by means of the effect of inspiration and expiration upon the great vascular trunks. Whether the heart may be directly aroused to new activity by the reflex action of the irritants or not, will only be decided with the controversy concerning the origin of the nerves of the heart.

The fact that cutaneous irritants do not redden the surface of a dead body, and that the cutis, denuded by taking off the epi-

dermis, does not furnish an exudation, but soon dries up, is to be explained from the loss of nervous irritability.

2. The body, in which all reciprocal change of matter has ceased, as a matter of course grows cold, the more rapidly, the lower the external temperature. As the animal tissues are bad conductors, the internal heat is often retained for a long time. A lower degree of the same, which may be ascertained by the introduction of a thermometer into the œsophagus, argues still more decisively for the actual commencement of death.

3. I have already mentioned, that the manner in which the blood flows out of opened arteries, serves as a measure of the force of the heart. When the heart stands still, when the arteries have lost their tone, and have become dilated again after expelling the blood into the veins; when, in addition to this, a coagulation of the blood has perhaps already commenced, then the opened vein furnishes no blood at all, or only a few drops. Still, a similar atony also happens in transient paralytic conditions of the vascular system, and bloodletting, therefore, furnishes only a doubtful criterion.

4. It is in consequence of destroyed turgescence, that a dead body becomes flattened down in those parts upon which it rests.

5. The blood, in obedience to gravity, deposits itself in the capillary veins of the most dependent portions of the body, and thereby produces bluish-red, so-called gangrenous spots.

6. The contents of all cavities and reservoirs which contain fluids, infiltrate and extravasate in the surrounding parts. On this account, we find, by dissection, the parts around the gall bladder tinged yellow, the walls of the blood-vessels frequently tinged red, the central organs softened by the absorbed cerebro-spinal fluids, &c. This change of external parts, and these signs of death, become perceptible in the eye, which recedes in its socket, and loses its elasticity, whilst at the same time, by relaxation and thickening of the epithelium, the cornea becomes clouded and whitish.

7. The rigidity of the dead, rigor mortis, belongs to the decisive signs of absolute death. It seems to take place in all the contractile tissues, and even in the cellular tissue, but is most

striking in the muscles of the trunk, and only in these is useful as a means of diagnosis. It always commences in the jaws and neck, then proceeds downwards on the back, over the arms, and finally down the legs, and then disappears in the same succession. It commences earlier or later, according to the cause of death; the earlier, the more the muscular power was exhausted before death; and, after violent tetanic spasms, the transition of spasmodic contraction into the rigidity of death, has been seen almost immediately. In the rule, it appears within twelve hours after death, and disappears after a continuance of from thirty-six to forty-eight hours. By this rigor, the muscles become firm, shortened, and thickened, as in health occurs only upon the impulse towards motion; the limbs become moderately bent, the under-jaw, if it hangs down at first, now becomes closed again, and the face regains an almost living expression. The rigor mortis is distinguished from spasmodic contraction, by the fact that the muscles, once forcibly stretched, do not again contract, but remain soft and flabby. The rigidity of the dead body seems to be a never-failing sign of death; and in those cases where it is not observed, it only seems to have occurred so early, and passed away so quickly, that it has been overlooked.

The cause of this remarkable phenomenon has been and is still unknown. Cold accelerates its appearance, but keeping the body warm does not stop it. The opinion which, until within a short time, has met with the most approbation, namely, that the rigor mortis is occasioned by the coagulation of the fibrin in the muscles, may be considered as refuted; because we find contraction of the muscles in cases where the blood has remained fluid, and it is not prevented by the injection of substances which destroy the coagulability of fibrin.

But it is for that very reason, that the rigor mortis is such an infallible criterion of absolute death, because its commencement denotes exactly in every muscle the termination of irritability. Where a muscle, or a bundle of muscles, was still soft, Bruch found it still sensitive to galvanism; and in the instant when it could no longer be convulsed, it began to be rigid.

8. With the termination of the rigor mortis, coincides the beginning of the infallible signs of decay, the cadaverous smell, and the development of gas, which, in summer, often causes, in a very short time, a complete loss of identity, swelling up the corpse so that it cannot be recognised, and often occasioning, after death, evacuation of the contents of the bowels, bladder, and even of the uterus, and, finally, the green color of the abdominal walls. At this time, the microscope demonstrates the presence of infusoria, to become whose food is the final destiny of the soulless organism.

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THE END.